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The Fifty-Ninth Meeting of the American Astronomical Society

By DEAN B. McLAUGHLIN

In June, 1933, the American Astronomical Society held a meeting in Chicago, in connection with "A Century of Progress." After further progress for a small but appreciable fraction of a century, it has convened once more in the Middle-West. The time-honored custom of meeting east of the Allegheny Mountains was finally abrogated by holding the fifty-ninth meeting at Indiana University, Bloomington, Indiana. The dates of the meeting were so arranged that they would not conflict with those of Section D of the American Association for the Advancement of Science, at Indianapolis. Those who met with Section D on Wednesday, December 29, were able to reach Bloomington that evening in time for the informal gathering.

Headquarters of the Society were at the Memorial Union. All sessions were held there, and a number of members had rooms (which were very comfortable) in the Union tower. The Society thus formed a small community fairly isolated from the world during the period of the meeting. Numerous cars belonging to members were parked in the drive in front of the Union beside a series of signs reading: "No parking at any time."

A meeting of the Council was held Wednesday evening in the Board room. Our host, Professor Cogshall, was invited to sit with the Council. He was present in person, and also looked down from the walls from several places in photographs of the Board of the Union. During the Council meeting and afterwards, members gathered informally in the lounge. This large room was used for the sessions for papers. It was furnished with large overstuffed chairs and settees which looked, and also felt, very conducive to repose, but it is believed that everyone stayed awake during the presentation of papers.

The first formal session opened at nine o'clock Thursday morning. Dean S. E. Stout gave the address of welcome, and President Aitken responded, remarking that he hoped we would so conduct ourselves that the University would be glad to welcome us again. After a few announcements the presentation of papers was begun.

The timing of papers was done in a perfectly objective manner, with an interval timer which rang an alarm at the end of the scheduled time of the paper. Very few authors ran overtime, and several stopped considerably ahead of time. Probably the coöperation of authors in making

papers concise,—and hence interesting,—kept members from dozing in comfortable chairs. Occasional recesses of five minutes also helped to keep the sessions from growing tiresome. The use of the timer is highly recommended, and it might prove even more effective if supplemented by a cuckoo clock set to go off five minutes later.

The customary photograph was taken at the end of the morning session. The job was done in record time, thanks to the energy and efficiency of the photographer, who is suspected of having been a "top"-sergeant in days gone by. The hatless and coatless condition of members does not imply balmy weather,—it indicates faith in the promise to get the thing over quickly. These promises have been heard before, but this is the only time in recent years when they have been kept.

The afternoon session at two o'clock began with the retiring address of President Russell: "The Place of Approximate Methods in Astronomy." It was quite short, as retiring addresses go, but very full of solid material. The writer, who has spent a good fraction of his life making inaccurate observations, found it consoling.

The retiring address was followed by another session for papers, and by the end of it about two thirds of the program was cleared away. During the later afternoon, tea for the ladies was served by Mrs. Cogshall and Miss Wells.

The Society dinner was held that evening at seven o'clock. Admission was by ticket, which bore a strong resemblance to those dispensed at motion picture theatres. This indicates great faith in the honesty of astronomers. An astronomical touch was furnished by the dessert; brick ice cream decorated with pink Saturns.

After-dinner speeches have become very rare in the American Astronomical Society in recent years, but this was a very special occasion. At the end of the dinner President Aitken presented the Annie J. Cannon Prize to Mrs. Charlotte Moore Sitterly, who spoke briefly in acceptance. Short speeches were made by Dr. John A. Miller, who, as professor of astronomy at Swarthmore, started Mrs. Sitterly on her astronomical career, and by President-Emeritus Bryan, of Indiana University.

During the remainder of the evening members sat about the lounge in small discussion groups. These included a pow-wow about VV Cephei, from which the participants retired more or less exhausted after eleven o'clock. A few stayed up until even later hours.

A second meeting of the Council was held Friday morning. It was followed by the final session for papers at nine o'clock. A few members left early to catch trains or buses, but the majority remained until the end. Mr. Clyde Fisher presented a resolution of thanks to our hosts, which was unanimously approved. President Aitken then declared the meeting adjourned, remarking that that day was "the pleasantest seventy-third birthday I ever spent."

An excursion was scheduled for two o'clock that afternoon, for the purpose seeing diamond saws cut limestone like so much butter. To the

writer, however, home was more attractive, and the number of excursionists is unknown to him. Some members expressed the intention of visiting the observatory, where a newly completed Schwarzschild reflector is installed. It was begun some years ago, and Professor Cogshall's story of delays and lack of funds sounds rather like that of some other observatories.

It will be impossible to give any digest of the papers presented. Suffice it to say that the program seemed unusually interesting. It was dominantly astrophysical in character and included a variety of topics: the solar spectrum, variable stars, the giant binary systems VV Cephei and ϵ Aurigae, Schmidt cameras, bird life of the South Seas, stellar temperatures, and planetary surfaces and atmospheres,—to mention some samples. External galaxies were conspicuously absent. What with the accurate timing, it was possible to present 49 papers, aggregating six and a half hours, and to discuss them adequately, in the three sessions. Five papers were read by title.

The hospitality shown the Society could not be exceeded. Professor Cogshall urged members: "If you don't see what you want, ask for it," and the faculty rooms of the Union were open to astronomers "for billiards, or anything within reason." No pains were spared to make the visitors comfortable. Most members had meals in the Union grill; the food was excellent and the prices agreeably low.

The Council admitted several new members (one optimist sent on his check for dues) and voted to hold the next meeting in September, 1938, at the University of Michigan.

Meeting of Section D (Astronomy), American Association for the Advancement of Science

By HARLAN TRUE STETSON*

The American Association for the Advancement of Science held its winter meeting at Indianapolis, December 27 to January 1. Section D (Astronomy) had its headquarters at the Lincoln Hotel with a schedule for two sessions of papers, Tuesday morning and afternoon, December 28, and one in joint session with the American Meteorological Society on the morning of December 29.

As the meetings were arranged just prior to those of the American Astronomical Society in Bloomington, a considerable number of astronomers stopped for the sessions. One of the principal features was the address of the retiring vice-president, Dr. Frederick H. Seares of the Mount Wilson Observatory. The address, entitled "Magnitudes Again," is printed in full in *Science*. Other papers on the Tuesday sessions in-

*Secretary of Section D of the A.A.A.S.

cluded contributions from Harvard, Massachusetts Institute of Technology, University of Michigan, University of Kansas, Pasadena, Victoria, and elsewhere. While most of the papers dealt with the spectroscopic or photometric side of astronomy, "Reinmuth's Object," "The Saros," and photographs from the new Mount Palomar Observatory varied the program.

The Wednesday morning session concerned itself chiefly with papers likely to be of interest to meteorologists as well as to astronomers. While most technical papers on astronomy can scarcely be said to touch upon subjects even remotely connected with the sciences which bear more directly upon the welfare if mankind, three papers touched upon subject matter that may ultimately suggest developments which concern terrestrial sciences.

One of these, contributed by Adel and Lampland of the Lowell Observatory, announced the discovery of a new constituent of the earth's atmosphere, nitrogen pentoxide. The discovery was made possible through the recent identification in the laboratory of the absorption band at 7.6 μ, definitely identified as characteristic of the molecule N_2O_5. The unusually dry climate of Arizona was necessary in order to make possible the separation of this band in the earth's atmosphere from the broad water vapor band in the spectrum that obscures it except on days when the atmospheric water vapor content is low. Since nitrogen pentoxide appears to be formed in the ozone region, its formation may well be associated with ionization in the ionosphere near the radio ceiling that is of ever-increasing interest to the earth sciences. It appears not impossible that variations in the newly discovered band of N_2O_5 may yet be useful in determining small variations in the ultraviolet light component of solar radiation since the stability of N_2O_5 lends itself particularly to further researches towards this end.

A paper by Dr. Dinsmore Alter, who has long interested himself in cycles of solar activity and rainfall, threw new light on the hope of untangling the mysteries of a suspected short-period variation in solar activity through a discovery of a recent displacement in longitude of centers of solar eruptions. When allowance is made for these irregular displacements in longitude, the possibility of a more nearly fixed 15-month period becomes evident, according to Dr. Alter.

Closely allied to the problem of solar and terrestrial relationships was a paper by Professor Claude W. Bruce of Wesleyan College, Macon, Georgia, which presented striking evidence for a marked relationship between river flow and the sunspot cycle. Correspondence was particularly striking for rivers like the Mississippi which cover a wide drainage area and whose level shows positive correlation with rainfall. The sessions closed with an account of the National Geographic-Naval Observatory eclipse expedition to Canton Island given by Professor S. A. Mitchell, scientific head of the expedition and director of the Leander McCormick Observatory at the University of Virginia.

An informal dinner was held at the Lincoln Hotel on Tuesday evening, at which Dr. R. G. Aitken, recently elected president of the American Astronomical Society, was the guest of honor.

Dr. Philip Fox, Vice-president and Chairman of the section, presided, on Wednesday morning jointly with Mr. Joseph B. Kincer, President of the American Meteorological Society, and also with Dr. Aitken.

The Comet-Seeker Hoax

By HEBER D. CURTIS

"The Doorkeepers of Zion,
They do not always stand
In helmet and whole armour,
With halberds in their hand;
But, being sure of Zion,
And all her mysteries,
They rest awhile in Zion,
Sit down and smile in Zion;
Ay, even jest in Zion;
In Zion, at their ease."

KIPLING.

All who have delved into the history of astronomy in America have chuckled over The Great Moon Hoax, perpetrated in 1835 by a graceless reporter of the *New York Sun,* Mr. Richard A. Locke. This represented the younger Herschel, at that time in South Africa on his expedition to catalogue the nebulae of the southern heavens, as improving the performance of his telescope, through quasi-scientific methods unknown to optical science, until he could observe cities, buildings, and even human beings on the moon.* South Africa was distant and communications slow, so that before Herschel could deny the story this most successful astronomical hoax of all time was accepted and acclaimed by scientists and learned societies all over the world.

Few astronomers of the present day know of an equally delicious hoax perpetrated on Professor E. E. Barnard in 1891 when Lick Observatory and its staff of young giants were at their beginnings; it is the purpose of this short note to conserve this hoax for the astronomer of the future. Professor Barnard himself told me the story as we were rolling down from Manila to Padang to observe the total solar eclipse of 1901 in Sumatra, and his niece, Miss Mary Calvert of Yerkes, was fortunate enough to find, in the papers left by Barnard, the original newspaper clipping which she kindly loaned me, as well as other matter and letters referring to the hoax.

*Republished in book form in 1859: *Locke, Richard A.*, The Moon Hoax, or a discovery that the moon has a vast population of human beings.

The field for a successful hoax was ploughed and ready. Barnard was already world-famous as a discoverer of comets; in addition to those he had found earlier at Nashville, he had discovered five since joining the staff at Lick Observatory; as a matter of fact, he was to find three more in what remained of 1891, a world's record for one man in one year. Though the sensitivity of selenium to the action of light had been discovered in 1873, this property was just beginning to attract the attention of the public through the press in 1891, helped perhaps by the fact that Professor Minchin was that year trying to measure the light of the stars with a selenium cell.

One other fact is needed to form the background of the hoax. In every year of the forty-six years that have passed, and quite certainly in 1891 and earlier also, the youngsters of every large observatory staff have beguiled the monotony of guiding at their telescopes by dreams of some method of automatic guiding, where the selenium cell or some similar device should relieve them of the eye-strain and close attention incident to guiding their instruments. Perhaps we are today closer to some such labor-saving device through the employment of the photoelectric cell, though most astronomers of experience feel that it will never be possible to dispense with the man behind the gun for the careful guiding necessary in most types of celestial photography.

Suffice it to say finally, after the above preliminaries, that Professor Barnard was astonished and horrified to read in the *San Francisco Examiner* of March 8, 1891, a closely printed account filling two complete newpaper columns, describing his invention of an automatic selenium cell comet-seeker that

"DISCOVERS COMETS ALL BY ITSELF

THE METEOR GETS IN RANGE, 'ELECTRICITY DOES THE REST.'

A Wonderful Scientific Invention that will do away with the Astronomer's Weary Hours of Searching—The Idea Founded on the Spectrum of the Comet's Light—It's Just Like Gunning for Wandering Stars with a Telescope."

The joyous journalese of the headlines then gives way to a story that could have been written only by an astronomer, though there is the occasional attempt to make it read as the mythical signer of the article, one Collis H. Barton, might be imagined to write it. Three cuts illustrate the article,—a view of the complete comet-seeker, a diagram of its objective prism, and even the electrical circuit of its Wheatstone bridge. Be it remembered here that Keeler used to make sketches of unusual neatness and finish,—even for the transit instrument he built when a boy.

We can not hope that the Editors of POPULAR ASTRONOMY would give space for reprinting the entire two columns of this delightful hoax with its three illustrations, but extracts follow:—

. . . The comet-seeker has a hard time of it, exposed, as he needs must be, to all sorts of weather, in the open air, with no protection from the wind, at all hours of the night, sweeping over every square degree of the sky with all his powers of acuteness at the highest pitch, lest the faintest object should be overlooked . . . But in the interests of knowledge some must undertake the task.

This, however, is the age of invention, and the following graphic account of mechanical comet-seekers discovered by one of the professors at Lick Observatory . . . is of great interest to all who pay the slightest attention to astronomical subjects.

. . . At first the astronomers were loath to discuss anything relating to the new machine, but . . . to prevent a garbled version of the story, Professor Barnard himself explained this invention to me.

"You see," said the renowned young astronomer, "The idea has been revolving in my mind for many years. The mechanical details were clear enough in my mind and all I needed was the disclosure of some peculiarity in the comet's light which would announce itself immediately on entering the field of the telescope. I felt that spectrum analysis of the comet was a necessary preliminary, and therefore suggested my dilemma to Professor Keeler.

"Now Keeler knows all that is worth knowing about the spectroscope, and we studied the matter out together. It is known that the spectrum of each and every comet so far observed consists of three bright hydrocarbon bands, in the yellow, green and blue portions of the image . . . In the case of an ordinary star or planet these three central bands are absent, the light of the star being uniformly distributed throughout the spectrum. Evidently this peculiarity of the comet's light had to be utilized, but how?

"Presently Professor Schaeberle joined the party, and listened to the discussion. Now Schaeberle is pretty well posted on electrical and mechanical matters, Keeler, as I have said, is a thorough spectroscopist, and I know a thing or two about comets, and among the three of us we soon had the problem solved. Come up on the roof and I will show you the invention."

. . . Professor Barnard uncapped the lens and showed the prism in front of the objective. "The light," he said, "of any object toward which the telescope may be pointed, is immediately dispersed by the prism, and passes through the object glass. In place of the ocular is a metallic diaphragm with slits cut exactly in the positions of the three hydrocarbon bands I have mentioned. Back of this diaphragm is a strip of the metal known as selenium, which, as you may be aware, is electrically affected by the action of light. This strip of selenium forms one of the sides of a 'Wheatstone's bridge,' from the points of which run these two insulated wires connecting with the battery room . . ."

Then Professor Barnard called my attention to the base of his comet-seeker, in which, by opening a door, he disclosed two entirely separate pieces of mechanism, one of which, he said, was designed to give the telescope a somewhat rapid, sweeping motion, first from west to east, covering the semi-diurnal arc in about ten minutes of time, and then shifting, by an automatic gear, northward a distance equal to two-thirds the 'field' of the telescope (or say 40 minutes of arc), whereupon the instrument slowly returns to the west point of the horizon—and so forth. The other was recognized as the ordinary clock-work motion of an equatorial telescope, upon which principle the comet-seeker was mounted.

"Mark now the effect!" cried Barnard, almost rapturously: "When the moon goes down I will start the telescope 'sweeping,' as we call it, commencing at the southwest point of the horizon. Farther south than declination —35 degrees any search would be hopeless in this latitude. Having ascertained that the clockwork is wound up and working . . . I leave my comet-seeker to its own intelligent work, and give my attention to stellar photography and other important matters. Throughout the night my human telescope explores the skies. Stars, nebulae, and clusters innumerable crowd into the field with every advance of the clock, but the telescope gives no sign of their presence, for the analyzing prism spreads

out the light of even the brightest among them throughout the length and breadth of the spectrum, and when this spectrum falls on the three slits of the diaphragm its light is far too feeble to exercise any electrical effect upon the selenium . . .

"But let even the faintest comet come into range, and see what are the consequences! The prism instantly analyzes the light, the omnipresent bright hydrocarbon bands fall upon their respective slits. The light of these, reaching the strip of selenium, so changes the electrical resistance as to disturb the balance of the Wheatstone bridge, and a feeble current is sent through the wire. This in turn closes all the circuits of the powerful Leclanché battery, and the comet is caught, as in a trap.

"An alarm-bell rings in my bedroom down at the cottage. Of course, the signal quickly summons me to the roof. I remove the prism thus, and, without disturbing the adjustment of the instrument, detach the box containing the diaphragm, etc., and substitute an ordinary eyepiece, in this manner. A single glance should suffice to reveal the position of the newcomer.

"Have I tested my invention? Certainly, or I should not speak so confidently. You remember reading of the comet discovered by Professor Zona, at Palermo, November 15th of last year? Well, this comet was fairly bright at discovery, but last month, when my machine was just completed, it had become sufficiently faint to be a most severe test. One night, when all the conditions were favorable, I started the finder several degrees from the comet's position, and allowed it to sweep back and forth in the heavens. Sure enough,—the distant body—barely visible to the eye through the same object glass—was instantly detected, and my experiment proved a complete success.

"You may be sure that I feel pleased; not so much for the honor of the thing (which we all share), but at the immense saving of valuable astronomical time . . ."

By this time I had been so impressed with the grandeur of this invention perfected by these modest workers in astronomical science that I felt impelled to decline their generous offer of further entertainment, and, full of the subject, returned to San Jose with their entire permission to make the facts public . . . I am happy to be allowed the honor of communicating to the world this brief sketch of a new invention, which will revolutionize at least one branch of astronomical investigation.

COLLIS H. BARTON.

San Francisco, March 6, 1891.

Professor Barnard, naturally, at once sat down and wrote hot letters of denial to *The Examiner* and to other San Francisco papers. But he had not reckoned on the Machiavellian foresight of some rapscallion colleague. The editors of the San Francisco papers had, one and all, been "primed" in advance, and not one of them would publish a line of his frantic disclaimers. And so, for the next two years, Professor Barnard received letters from all over the world, requesting details and specifications of his new automatic comet-seeker! Even that veteran discoverer of comets, Lewis Swift, more than half believed the tale, for he wrote to Barnard a few weeks later,—

"I have received the *San Francisco Examiner* containing an article regarding your invention to search for comets while you are asleep or using the 12-inch or playing poker. It takes my breath away and makes my hair stand straight towards the zenith to think of it.

Although the article appears somewhat fishy I am inclined to think it is still another of the marvelous inventions of the 19th century. I can hardly sleep till I hear more about it officially. I hope you will not fail to do it. The article appears to have been written by an astronomer . . ."

Dear Professor Barnard! He was an astronomical Peter Pan who never grew old, and whose every waking thought was concerned with his beloved science; hence this supposed "invention" must have seemed a clear case of *lese majeste* to him! Even as he told me the story, ten years after the event, he was able to summon only a rather wan and rueful smile.

As the *U.S.S. General Alava,* a gunboat captured from the Spanish in 1898 and carrying the Naval Observatory eclipse party to Sumatra, made one of her justly famous rolls in the long swells of the Indian Ocean, I asked Professor Barnard, "And did you ever find out who was the actual author of the hoax?" "Well, I never was sure," he answered, "but I have always suspected Keeler."

This seems not improbable, from internal evidence and particularly from the sketches. Doubtless no one will ever know with certainty, as all of that strong young staff have now passed on,—Barnard, Burnham, Keeler, Schaeberle, and Hill. Keeler himself was to leave within a few months to become director at Allegheny Observatory, to return seven years later for an all too brief tenure of the directorship at Lick Observatory. Some of that staff, like Barnard himself, were so serious minded where their chosen field was involved that we can not picture them as authors of the hoax, but Keeler was always ready to laugh at other astronomers, or at himself, if need be.

Barnard's suspicion may have been based on evidence now lost, but Keeler quite certainly had a fellow conspirator or a "local agent" in the person of Mr. Charles B. Hill, earlier an assistant at Professor Davidson's Observatory in San Francisco, who spent only one year on Mt. Hamilton and was living in San Francisco at the time the hoax was perpetrated. For *The Examiner,* very handsomely though very belatedly, apologized on its editorial page two years later, under date of February 5, 1893, soon after Barnard had discovered the fifth satellite of Jupiter:

> ". . . *The Examiner* seizes the opportunity to express contrition for the annoyance which it caused this eminent scientist by printing some time ago an account of a highly ingenious, but non-existent, machine for scanning the skies and catching wandering comets on the photographic plate. The inventor was Mr. Charles B. Hill, himself an astronomer of repute, who in order to give a greater appearance of substance to his fancy attributed the origin of the device to Professor Barnard, never thinking that the story would be taken seriously by experts. In this he was mistaken, for the scientific journals of America and Europe were all sold. . . . Of course the reputation of a man like Barnard is not to be affected by such a gentle hoax, but nevertheless the *Examiner* extends its apologies and wishes him all the new moons and comets that may be necessary to his happiness."

And with this we must leave the not fully answered question of the actual authorship of The Comet-Seeker Hoax.

The Observatory, Ann Arbor, Michigan, October, 1937.

The Partial Lunar Eclipse of 1937 November 18

By ALEXANDER POGO

There will be no penumbral eclipses of the moon until 1940. Data on the limits of visibility of lunar appulses may, however, be collected by observing the penumbral phases preceding and following the umbral phase of a total or partial eclipse of the moon. Partial eclipses are better suited to the study of the optically effective inner layers of the penumbra, because the moon remains longer in these layers in the case of a partial than in the case of a total eclipse. A small partial eclipse, like the one of 1937 November 18, is, of course, characterized by a longer path of the moon through the penumbra than a partial eclipse of considerable magnitude, like the one of 1939 October 28 (magnitude, 0.992, according to the *American Ephemeris;* in Oppolzer's *Canon* this eclipse is listed as total).

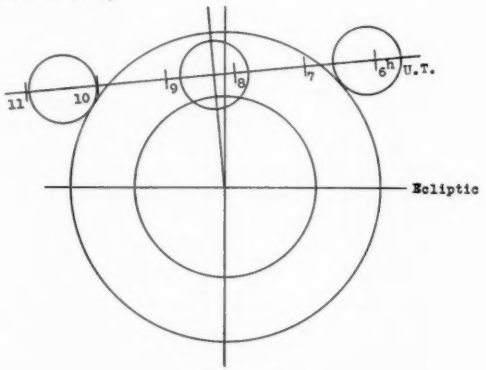

FIGURE 1
THE PARTIAL LUNAR ECLIPSE OF 1937 NOVEMBER 18

In addition to the length of the path of the moon through the penumbra, we must take into consideration the speed with which the moon overtakes the shadow; the seasonal variations in the speed of the shadow in the ecliptic are small; the difference between the hourly motion of the moon near perigee and near apogee is, on the other hand, considerable. The penumbral lunar eclipse of 1937 May 25, discussed in a previous paper,[1] occurred some nineteen hours after apogee; the moon moved slowly in its orbit, and its relatively short crossing of the penumbra lasted $4^h\ 20^m$. The partial lunar eclipse of 1937 November 18 occurred about seventeen hours before perigee; the moon moved rapidly, and its

[1] The Limit of Visibility of Penumbral Lunar Eclipses. POPULAR ASTRONOMY, **45**, 349-352, 1937.

path through the penumbra and part of the umbra was relatively long; the duration of the eclipse, from the first to the last contact with the penumbra amounted to $4^h\ 19^m.6$, according to the *American Ephemeris* (see Table I), or to $4^h\ 18^m.1$, according to the *Connaissance des Temps*.

TABLE I

CIRCUMSTANCES OF THE PENUMBRAL LUNAR ECLIPSE OF 1937 NOVEMBER 18
(According to the *American Ephemeris*)

Moon enters penumbra	November $18^d\ 6^h\ 9^m.1$ U.T.
Moon enters umbra	$7\ 37.1$
Middle of the eclipse	$8\ 18.8$
Moon leaves umbra	$9\ 0.5$
Moon leaves penumbra	$10\ 28.7$

Magnitude of the eclipse = 0.150 (Moon's diameter = 1.0)

The fact that the eclipse of 1937 November 18 occurred near perigee decreased, to some extent, the precision of the determination of the beginning and of the ending of visibility, *i.e.* of the encroachment of the moon's limb on the optically effective inner layers of the penumbra. On the other hand, the southern limb, obscured on November 18, offered a much more favorable background for the observation of the encroachment than the northern limb could offer during the eclipse of May 25.

The present report is based on the writer's observations made at Washington, D. C., in the morning hours of Thursday, November 18, 1937. The sky was clear and transparent at the beginning of the penumbral phase; light clouds reached the moon at the beginning of the umbral phase; from $7^h\ 46^m$ until $8^h\ 30^m$ U.T., observations were limited to glimpses of the moon through large rifts in heavy clouds; no attempt was made to observe the second half of the eclipse.

Cloudy weather seems to have prevailed, at the time of the eclipse, along the terrestrial "terminator," *i.e.* along the sunset and sunrise regions of the earth, because the amount of sunlight refracted by the atmosphere into the umbral cone was small, and the inner layers of the penumbral cone—at least of that part of the penumbral cone through which the moon was passing—were remarkably dark.

The "period of hesitation" preceding the "observed beginning of visibility" covered at least five minutes; at $7^h\ 12^m$ U.T., when the penumbral darkening could be described as "suspected," the magnitude of the penumbral phase amounted to —0.21. The penumbral darkening of the southeastern limb became quite obvious to the unaided eye at $7^h\ 17^m$ U.T., twenty minutes before the beginning of the umbral phase; computations show that the corresponding magnitude was —0.17. At $7^h\ 32^m$ U.T., five minutes before the beginning of the umbral phase, a flattening of the southeastern limb became clearly visible to the naked eye; the magnitude corresponding to this phase was —0.04; this flattening of the lunar disk by its immersion into the dark inner layers of the penumbra was "suspected" a few minutes earlier. When the flattening became unmistakable, at $7^h\ 32^m$, the limb of the moon was still 74″ from the physical umbra, or 128″ from the geometrical umbra. During the

eclipse of 1937 November 18, the innermost layers of the northern part of the penumbral cone must have been so dark that the limb of the moon appeared flattened by immersion into them when the limb was more than 1′ from the physical umbra, or more than 2′ from the geometrical umbra; a comparison of this observational result with the results obtained during the eclipses of 1938 and 1939 would contribute to our knowledge of the degree of conspicuousness of close lunar appulses; a flattening of the darkened lunar disk ought to be observable during the penumbral lunar eclipses of 1944 December 29 (magnitude, —0.03) and of 1948 October 18 (magnitude, —0.06); a slight flattening of the disk is possible but improbable during the penumbral eclipse of 1940 April 22 (magnitude, —0.09).

This concludes the writer's report on the initial penumbral phase of the eclipse of 1937 November 18. A few words may be added concerning the appearance of the moon during the umbral phase. As the moon approached the umbra, the missing plano-convex part of the southeastern limb took the shape of a biconvex dark encroachment. At $7^h\,39^m$ U.T., two minutes after the beginning of the umbral phase, the eclipsed limb appeared to the unaided eye as very conspicuously concave; during the observed part of the umbral phase, the edge of the umbra remained sharply defined, separating the almost invisible biconvex encroachment from the slightly dimmed disk.

With a Zeiss Telita (6×) binocular, the penumbral darkening was estimated as covering one third of the moon's diameter at $7^h\,16^m$, and one half of the diameter at $7^h\,24^m$. During the umbral phase, the glasses brought out a brownish penumbral fringe surrounding the edge of the umbra; the fringe was rather dark near the umbra, and gradually merged into the colorless dull penumbra which covered the rest of the disk. The skyward edge of the biconvex umbral encroachment appeared, against a very dark sky, as a gray fringe bulging out from the moon's disk, not unlike an inner tube bulging out of a slit tire. The biconvex umbral encroachment, between the gray fringe along the skyward edge and the brownish fringe along the moonward edge, was of a very dark gray color.

The Constellations

By WILLIAM H. PICKERING

Seated one day in a comfortable chair I listened to a discussion of various school students who were standing near me. The topic of conversation was Astronomy. I was surprised to hear what sensible questions were mostly asked, but one boy's question particularly interested me. I was told that he was 15 years old. He asked the teacher who was with them what were the names of the most prominent constellations in the heavens, as he wished to make a special study of them. The teacher gave him a list of about 50 constellations, and it struck me at

once that that was not what the boy wanted, although it was perfectly correct.

On my way home I thought over the question and answer, and it struck me that although I had pointed out the constellations to many people I had never been asked which were the most important ones. Immediately I sat down and made out a list giving the most important constellations. It appeared to me that this list would be of more use to the boy than the one given him by his teacher.

List of Prominent Constellations

	Proper Names	*Common Names*
1.	Orion	Great Nebula
2.	Ursa Major	Charles' Wain, Dipper, Bear
3.	Cassiopeia	W
4.	Scorpius	Scorpion
5.	Taurus	Bull
6.	Leo	Lion
7.	Gemini	The Twins — Castor & Pollux
8.	Capricornus	Sea Goat
9.	Sagitta	Arrow
10.	Sagittarius	Archer 2 bows
11.	Boötes	Hunter Pursuing Bear — 2 dogs
12.	Corona Borealis	Northern Crown
13.	Perseus	Greek Hero
14.	Delphinus	Dolphin
15.	Cygnus	Swan

In addition to these we might well make out another group consisting of southern constellations not visible in the north.

On first seeing Crux, the Southern Cross, almost everyone is disappointed. I attribute this to the fact that it is only in the form of a very irregular cross. The stars are of very unequal brilliancy, one being very faint. Furthermore, our ancestors, some of them being very religious, did not wish to include the stars called the Two Followers in the constellation. If we include them the constellation is a very fine one.

There is a northern cross which consists of the constellation Cygnus but it is not a brilliant object and is only mentioned on account of its shape. There is still a third object which is known as the false Cross. It precedes the true Southern Cross by three hours. The false Cross is found in Right Ascension 9^h and Declination $-54°$, and is the most conspicuous cross in the heavens.

There is another cross, however, which could very properly be mentioned, in the constellation of Orion. It consists of the three bright stars in the belt and a star nearly as bright below the sword-handle θ. This bright star is ι. These five stars with the sixth one below the belt give the cross a perfectly uniform shape, and the stars are of nearly uniform brightness. They form a little group by themselves placed in the heavens with the central line running north and south. This group is approximately the size of the Southern Cross. The writer has never previously heard this cross mentioned, but he thinks that it is at least as satisfactory as any of the others.

Mandeville, Jamaica, July 9, 1937.

Signs of the Zodiac

By F. M. GARLAND*

When anything is suggestive of something else, it has a meaning: it is a sign, or symbol. For instance, the well-known pictures of "Uncle Sam" and "John Bull" are, to the minds of even very small children, emblematic of two great nations. As early as the 14th century English law compelled merchants to adopt and use signs in the practice of their trades; the old Roman tavern was known by the sign of a bush; the Babylonians inherited a system of signs and names from the Accadians; the examination of tablets, whose ages run back to 3000 B.C. or more, points to the existence of signs that certainly antedated that period, and we may safely say such tablets were merely head stones marking the graves of long forgotten thinkers who tried by sign, symbol, and mark to leave a history of their time and place.

Somewhere, in antiquity, the signs of the Zodiac were born. Perhaps they were changed from the original, just as signs and words during our own short span of life change in form and structure. For many years it was believed that the constellation names and zodiacal signs were Greek in origin. But a discrepancy was discovered between Hellenic mythology and names of star-groups. The probabilities are that the Greek constellation system, as we know it, goes back to Semitic or pre-Semitic origin. Even in the time of Hipparchus (Greek astronomer about 150 B.C.) the signs of the Zodiac did not correspond with the actual positions of the constellations, which indicates that, using a modern phrase, while "the Greeks had a name for it," the honor of inventing original Zodiacal sign language goes to some antiquarian whose name will ever be a mystery.

We can try to decipher these signs and make a guess at what they meant when drawn. Each one, in order, will be described with purely conjectural remarks as to the construction of the symbol itself.

The man who day-dreams is a type, psychologically speaking. His attitude at such time may often be caused by external influences which affect his daily life; he is embraced by the warm waters of meditation. Drowsily, he sees through half-closed eyes a vision that is not real. A finished artist has the ability to paint or draw a picture that exists only in his own mind. A draftsman copies what is before him. A cartoonist will employ certain designs or technique, but the result usually crystallizes some exposition of an idea.

One time, long ago, man tried to express himself through pictorial representations. He saw figures in the sky that were not actually true; but he did his best to execute a likeness of his observations in an abbrev-

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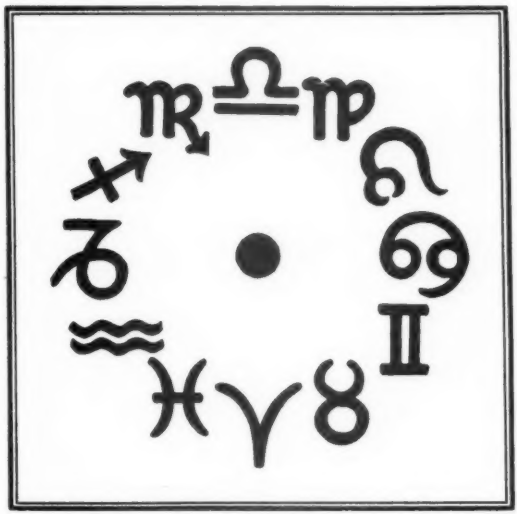
iated way. Now, he knew what the head and legs of a sheep or ram looked like and, in the best manner of his time, he made a sketch which served his purpose of identifying that animal. So we shall begin with the first sign of the Zodiac.



THE SIGNS OF THE ZODIAC, IN ORDER BEGINNING AT BOTTOM AND PROCEEDING COUNTERCLOCKWISE.
(Reproduced, by permission, from "Astronomie, Tatsachen und Probleme," by Oswald Thomas. Published by das Berglandbuch, Graz, Germany.)

ARIES, THE RAM

The sign he drew of the Ram closely resembles the horns of a ram, and bears also a relationship in figure to an obtuse angle formed by the three principal stars in the constellation Aries. Some authorities think that these three stars, whose positions seem to be in the same shape as the hind leg of a sheep or ram, instigated the thought of such an animal; it could also reasonably follow that the three-pointed V was readily converted into a miniature horned figure by adding the curls at the top, to form the sign as it was and is still used. Curiously enough, if it were left to you and to me today, our selection would not be different.

TAURUS, THE BULL

The sign of the bull is about as a small child would portray it if called upon to do so in the class-room, perhaps slightly elongating the circle where the nose would extend. In such a simple manner the sign must have first been made. If Taurus was the original leader of the Zodiacal constellations, then it marked the vernal equinox and heralded the open-

ing of spring with the welcoming heat of the sun. To simplify matters and still carry on the scheme of using a circle identifying the sun, the horns were added, thus not only finishing a sign picture depicting a bull to represent the constellation, but also indicating that the whole sacred figure was charging at the head of his host commemorating the advent of May Day.

Gemini, the twins

Who knows but that some day an enterprising amateur astronomer may invent a new series of names for our constellations and call one of them the Quintuplets, re-naming Corvus, for example, whose five brightest stars now are supposed to resemble a crow. Apparently twins were the pride of that period. So those two bright stars in this constellation, always together, every night, could have but one meaning—twins! And so they were called. The sign is clear, two straight lines, symbolizing the equal days and nights of the season over which they held power then, say six thousand odd years ago, marking the equinox. The Egyptians saw in this constellation a couple of young Kids; the Greeks altered the symbol to associate the brothers Castor and Pollux; the Arabians thought the two bright stars typified a couple of peacocks. The tabulator of the sky patrol made no mistake when he chalked up two marks to cover his day's work.

Cancer, the crab

When most amateur astronomers see the constellation Cancer, they forget about its insignificant size and fix their attention on the Bee Hive cluster, located close to the center of the constellation. The ancients, however, did not have the assistance of telescopes, and we, at this late day, might feel constrained to name this group of stars the Bee Hive. The sign of Cancer looks somewhat like two letter b's, lying horizontally, one atop the other, so it is easy to remember the sign once we see it. While the grouping of those stars in Cancer, which are visible to the naked eye, may imaginatively form the figure of a crab, the Babylonians established the constellation as a tortoise, and the Egyptians placed it in their Zodiac as a beetle. The sign symbol probably denotes the pincers or claws of a crab or beetle. The Chaldeans, figuring the sun started an apparent backward motion upon reaching this sign, likened that motion, and the general outline of the star group, to a backward moving crab. So far as we know, then, the symbol must have been intended to represent two bent claws of a crab or beetle.

Leo, the lion

There does not seem to be any doubt as to what the ancient artist meant to portray when he drew this symbol. The tail, the curved back, the head, and the feet of a crouching lion, seen as a single line, have the sickle-figured front, and the sweep of a curved tail at the rear. The sickle formation of stars, beginning with the first magnitude star Regulus, bears a distinct resemblance to the symbol, except that the symbol

is humped in the center and is more complete in composition, indicating that a lion's figure was the object being drawn. In this long-ago period, the sun was pouring down its hottest rays; Leo, the ring master of all earthly and celestial animals, was running the show in the big tent. The sign may have been hewn in stone; with wrinkled brow the bare-foot predecessor of Michel Angelo may have first drawn the outline with a jagged rock on a piece of sand stone; whatever the tool, whenever the time, wherever the place, through wind, water, and flame, the mark has stood the test of time, its simplicity and form preserved for you and me.

Virgo, the virgin

The symbol sign of Virgo is subject to various interpretations. Some say it is a corruption or rather a contraction of the Greek word for Virgin and that this sign at one time was supposed to outline the figure of a girl, holding in her hands ears of corn, or sheaves of wheat. Virgo was the sign the sun entered at harvest time, and the Virgin of Greek mythology became a goddess who, in the minds of man at that period, ruled as queen of the harvest season. Mythologically the Virgin's name was Astraea, goddess of Innocence, Purity, and Justice. In a certain age, she resided on the earth; but, disappointed with man, his grabbing ways and utter selfishness, Astraea became so disgusted that she returned to heaven. So the story goes; but we must remember that the myth, as we know it, was perhaps written much later than the birth of the sign. Yet any maiden could still have carried sheaves of wheat and ears of corn. Queens of the harvest season were no doubt picked then as they are now. Even if the sign did precede Greek origin, the fields in day time and the stars at night were of such prime importance that they had much influence on the people. Man's work of that time was seasoned with his surroundings.

Regard, for a moment, the symbol of the Virgin: would it occur to you that it might be a picture of a pretty girl walking along a pathway in the field with two young swains to her right, all hand in hand? Or does it show her parading down the celestial board-walk, several boyish suitors quite properly on her right?

We can imagine, quite easily, something like this being at least the artist's conception, as he tried so hard to leave behind him a lasting sign of what he saw. And if these thoughts were running through his mind, he was not very far from the truth. Maiden and youth, laughter, love, rich harvest-time: always a pleasant picture to look upon. Down through the ages time has changed us very little in that respect.

Libra, the scales

In the old Chinese Zodiac, only animate objects were chosen as signs of the constellations. In the western Zodiac, just one inanimate object appeared—the Scales. Chinese, Arabian, Greek, Roman, Hebrew regarded this celestial figure as a balance or scale. Surely enough the outlying stars do form the contour of a scale such as you can see any day

on a druggist's prescription counter. And in turn this balance figure denoted the time of equal days and nights. Geometrically, the figure is simple, and from such simplicity has come an everlasting history of starry tides that still flow, unceasingly before the admiring view of man today. This evenly shaped constellation of stars may have conveyed many meanings to the sky gazers of long ago; but our old friend was called upon once more, commissioned to delineate, to the best of his ability, in what style of the day it would be best to clothe this aggregation of twinkling gems. As to the result may we only say of his selection: choice is, indeed, a rare gift.

Somebody had to compose these signs. Would it not be interesting to know if a prize was given for the best picture? And maybe an extra prize for an essay! What could the prize have been? In Egypt, perhaps a boat so the lucky man could use it on the Nile. Now if the artist in Arabia was really good, but not popular as a man, they could have given him a horse, hoping he would ride away and never come back. You can imagine a lot more things but you just cannot beat the perfection of their art.

Scorpius, the scorpion

Here again the impressionistic illustrator left behind him another imaginative mark which leaves no doubt as to his style. Compare the signs of Virgo and Scorpius: they are both by the same hand or school. Since the constellation forms the figure of a scorpion, the symbol may have been constructed after a closer examination of a live specimen of scorpion, using the tail and legs, or using the sting, tail, and some joints. There could not have been much relation to the time of year, so far as the symbol is concerned, unless the weather was particularly malignant in keeping with the venomous sting of a scorpion.

But while the sign painting of those days was certainly concise and briefly done, an artist of today, in his conception of a beautiful girl, and of a crawling thing, would hardly give you anything that would look so much alike as the signs of Virgo and Scorpius. Granted that he constellation was named long after the sign was drawn, the general resemblance of the naked-eye star group to a scorpion, the existence of scorpions, and the desire to faithfully leave a record understood by all, would be reason enough to believe that the crudely shaped symbol is not such a mystery; it is a test of the limit to which man extended himself under trying circumstances, his education confined to nature's school; his only tools rough and fashioned from sticks or stones.

Sagittarius, the archer

This sign was easy to sketch, chisel, or draw in the sand with a stick. There is no mistake about it showing an arrow leaving the bow of the archer, as readjusted lines joining the individual stars would do. The form is there. In figure drawing and composition, the embryo artist today is taught to show action, posture, shape; and one of the first steps is to perform this task by diagramming, in jointed straight lines, a dummy

figure which, if rounded out with half closed eyes, will suddenly come to life. So the Archer was conceived, and with him his bow and arrow.

At the time of year when the sun entered Sagittarius, the hunters must have felt the tingle in the air, and were eager to begin their autumn chase. If only they could have seen what the young star hunter of today shoots through his 6-inch telescope when he points it at Sagittarius: dark lines in the Milky Way; the little asterism known as the Southern Crown; a yellow and blue double; a multiple star, and beautiful, glorious star clusters. One marvelous cluster, which can be seen only through a large telescope, must contain over a million stars at a distance of about 100,000 light years! The hunter of old and the hunter of today —how their ambitions and accomplishments have changed!

Capricornus, the sea-goat

Of course we know there are no such animals as sea-goats, disporting themselves in the warm waters of the tropics or climbing rock bound shores of lands where colder sprays and chilling winds hold forth. In the fables we read to our children many exciting adventures and descriptions of fictitious characters or strange beasts cause wide-eyed wonder. They are just stories. The mother of old had no printed fairy tale books with colored pictures, and indeed very few toys with which to amuse her off-spring; but she had at her command a great magic lantern, a lantern that provided never-ending shows, and brought gurgles of delight from the boys and girls as each new slide appeared. And so the elders came to believe that as each assemblage of stars passed by in nightly review, they outlined the animals and things of their real world as well as those that dwelt in the land of fanciful dreams.

Now, the sun, arriving at Capricornus, begins to mount in the sky. Likewise, a goat, seeking safer feeding grounds, climbs the mountain side. In a catalogue that could be preserved only by memory and picture writing, this rather inconspicuous group of stars became known as a fixed representation of a climbing goat. Another explanation, limited in a way as to time and construction, is that the sign, in the form of a ligature, binds or combines the letters of the Greek word for goat. However, an examination of ancient Greek words used in Homer and Theocritus, as well as other ancient Greek words, and modern Greek usage, all meaning goat, fails to reveal any reasonable similarity between one letter or a group of such letters and the symbol as we know it.

The old Chinese Zodiac pictured this constellation as the Bull; but bull or goat, Far East artist or Greek sculptor, legacy or ligature, the sign still remains with us to this day, as a living record of one character in the movies of long ago.

Aquarius, the water bearer

Without question, the marks of this symbol represent waves of water. The stars in the constellation rise and fall as their positions are related to each other when you trace them from right to left; the four stars forming the water jar at the top of the group seem to spill a veritable

stream of stars trickling downward through the heavens; the Sea-Goat and the Western Fish are near by; and the sun is passing along this region of the sky while the earth is being deluged with rain. Everything seems surrounded with the very idea of water. How significant, then, is the implication of this sign, its sense, expression, import, and spirit. There is no complication to consider nor puzzle to solve. A few deft strokes, a sign comes to life; rippling water, deep and clear, reflects as a mirror, the face of an ancient man whose name means nothing, but whose memory cannot be erased.

Pisces, the fishes

Don't you remember, when you were little, trying to draw a fish, the result being something like two parallel curved horizontal lines, one above the other and intersecting near each end? Now shorten them, stand them up on their ends separated a little more, the curved sides pointing inwardly, add a straight line of about the same length through the middle from left to right, and you have the original symbol except that there are now three lines instead of two: you have simply added a string to your catch! In the sky, our talented sign-cartoonist saw the Northern Fish and the Western Fish with a long string holding them together. Could he have been thinking about the open season for fishing? The sun, entering this constellation, meant to him that the fish were hungry, ready to eat and to be eaten. Now the Chinese made a Pig out of this star group; but not so the Babylonians, Syrians, Turks, Persians, Greeks: they were real amateurs with vision and inventive, fertile minds. There they sat on mossy banks of clear streams, wooded shores of silvery lakes, clean white sands of the sea beach; dreaming, ingeniously plotting stories of the figures in the sky; indulging in conceptions that have withstood the ravages and contamination of time. We shall never know which of these ancients drew the sign of the fish. Suffice to say, the man must have stood out in his community as a leader, a person of authority, a man who could think and do things in a superior way.

Today, as we drive along our highways in the United States, we cannot see much of the country in some places because of so many sign boards. Often they are placed in front of eating places to attract your attention. Suppose the sign of Pisces were slightly dressed up and painted on a modern sign board, with a few alluring words to tempt you. The chances are that some famous fish-fry or shore-dinner establishment would be near by: the sign of the Fish!

Well, there isn't much more that can be added. These little signs of the Zodiac have scant attraction for most of the world today. Man, in his humble way of centuries ago, could have well understood the words of James Russell Lowell—

> *"Who deemeth small things are beneath his state,*
> *Will be too small for what is truly great."*

A Concept of Gravitation

By THADDEUS MERRIMAN

The law of gravitation was announced by Newton in 1687. It is a model of simplicity and marvelous accuracy yet, to this day, no satisfactory reason for either the law or the force has been stated. The concept herein developed is advanced as a possible explanation.

Assuming, as did Fresnel, an elastic ether of space we further assume that the atoms of matter displace this ether in a manner such as to set up a state of compressive stress therein around and about the atom. The ether thus exerts a pressure upon the atom and, as the distance from the atom increases, the intensity of the stress on each unit of area in the ether varies inversly with the square of that distance. This is true because the surface areas of the spheres around the atom on which the compressive stress in the ether is exerted increase with the squares of their radii. In Fig. 1 the shaded center A represents the atom; the concentric circles indicate the spheres and the arrows symbolize the directions of the pressures within the ether.

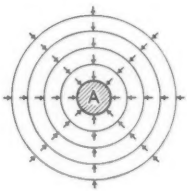


FIG. 1

If there were but one atom the pressure of the ether upon it would be balanced in all directions and there would be no tendency for the atom to move. In the case of two atoms, however, their fields of ether stress overlap and are superimposed upon each other with the result that each atom is compelled toward the other by the resultant ether pressure upon it. Thus, in Fig. 2, A and B are the atoms; the circles symbolize the fields of ether stress caused by the displacements of the atoms while the arrows indicate the directions of the resultant stresses within the ether. As the atom A displaces the ether in the field of B the resultant ether pressure at *g* on its left side is greater than at *h* on its right and it is thus compelled toward *m*. Similarly B is also compelled toward *m*. Each of the atoms is thus pushed toward the other and, as the ether stresses vary inversely with the square of the distance, the pressure or force acting on each of them varies in the same manner.

At *m* the resultant ether stress due to the displacements of A and B is zero. At *c* and *b* the resultants are directed toward *m* while at *e* and *f*,

as well as at g and k, they also act toward m. It also appears from Fig. 2 that the interposition of another atom between A and B will not alter their mutual gravitative action. In this case the effect is merely that of imposing a third field of ether stress on the two already existing fields and neither of them is altered with respect to its effects upon the other.

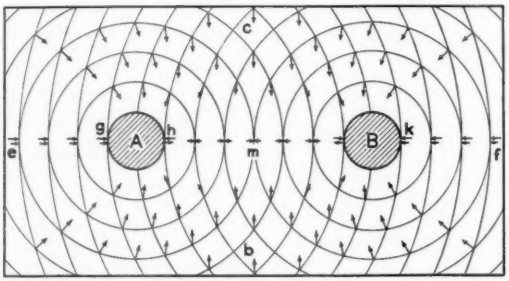


FIG. 2

When a large number of atoms are grouped together to form a body their individual fields of ether stress are superimposed so that they collectively form the field of the body. The condition around a single body is, therefore, similar to that around a single atom and the stress at every point in the ether acts toward the center of the body. Every body, like every atom, is thus compelled by the ether pressure toward the center of every other and the distance between two bodies is that between their central atoms.

The force which pushes each of two bodies toward the other (toward m in Fig. 2) is proportional to the number of pairs of atoms they contain and this number, in turn, is proportional to the product of the masses of the bodies. This appears from Fig. 3 where the body B is composed

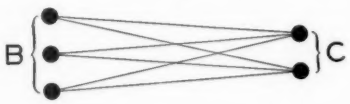


FIG. 3

of 3 atoms and the body C of 2. The number of pairs of atoms is the number of lines between the individual atoms of B and C. This number is 6 which is also the product of the numbers of the atoms in the two bodies. If each atom is a unit of mass then the force acting on each body is equal to the product of their masses and this, moreover, is true whatever the number of atoms they contain.

Thus does the law of Newton take on a definite meaning in terms of an exact and realistic mechanism and it appears that what we observe

and measure as the force of gravitation is the direct consequence of two equal convergent forces each of which is the reaction of the other. In the usual case when matter acts on matter, as when a box is pushed on the floor, action and reaction are equal and opposite in direction. When, however, the ether pressures resulting from the displacements of two bodies act on them ether acts on matter and action and reaction are convergent. This is one of the reasons why the facts of gravitation have been difficult to fathom.

On the basis of the concept here presented the abstraction of "action at a distance" is resolved as also is the doubt in regard to the "speed of gravitation." On our view gravitation does not move and is not transmitted from place to place. The sphere of ether stress around every body moves as the body moves. The ether pressure on every body, at every place and at every instant is, therefore, always appropriate to the distance. Time thus plays no part in the action of gravitation which is as omnipresent as the ether itself. Our postulates make it evident that matter moves freely through the ether because it is displaced by the atoms of matter. For a similar reason a ship moves through the water and a bird through the air. But the ether is a far more perfect entity than air or water and there is no "friction" when an atom moves through it. Ether cannot be compared with matter because it is not matter nor yet like matter. Its properies must be deduced from its observed behavior under many different conditions.

Besides indicating a cause for gravitation the displaceable ether renders it possible to explain the phenomena of Inertia, of Mass, and of Energy. The same mechanism also explains both attraction and repulsion between charges of Static Electricity while it further enables us to understand that Electricity and Magnetism are manifestations which become evident whenever the ether moves locally in relation to matter. These views will be presentd in the near future. In their development, as in the preparation of this note, I have had the important assistance of my son, Mansfield Merriman.

346 Broadway, New York City.

Fragmentary Notes on Astronomy in Japan

By YASUAKI IBA

(Part III)*

The Astronomer and Optician

Zenbei Iwahashi was one of the characteristic scientists of the time. A few astronomers were reported to have made telescopes by their own hands, and yet, strictly speaking, there is no confirmation of the fact that the optical parts were ground and figured by them.

*Parts I and II appeared in May, 1934, and June-July, 1937, respectively. As before, the form in which these "Notes" were originally presented has been followed, except in cases in which a slight rephrasing tended toward clearness.

On the contrary Z. Iwahashi was an optician, and had become an astronomer through self-cultivation. The fact that he had made a refractor himself is affirmed by an eminent scholar of his time, Kohkei Ban (Pen Name "Kanden") in whose famous miscellanies, published in the name "Kanden Jihitsu," there is interesting description regarding celestial observation that was held in the residence of Nankei Tachibana, with his colleagues under the auspices of Z. Iwahashi who demonstrated the marvels of his telescope.

The gist of the description runs as follows:

"The telescope which Zenbei Iwahashi had made is an octagonal tube with circumference of 9 Sun (Sun = 3.03 cm.) and its length about 10 times long." Excepting that which is installed in Government Observatory I hear no existence elsewhere. This is the first telescope manufactured.

On the 20th of 7th Moon (1793), a party of celestial observation was held in the residence of Nankei Tachibana, in which all who were present fully convinced themselves of the fact that by the aid of telescope one could observe the objects which were utterly invisible to the naked eyes, in conformity with the European theory. (Note. The only way of getting western information was then through Dutch literatures. The Dutch was studied by the progressive scientists of the time despite of oppression policy of Tokugawa Shogunate Government.) At first the Sun was observed, and found that from the periphery of the solar disk vapour like a hair radiated, and on its surface witnessed 5 black spots, dimension of which was different respectively.

According to Zenbei Iwahashi the black spots traverse the solar disk in a dozen of days and they are plentiful in winter and spring, etc.

By the evenfall he directed the telescope to the moon, which looked just as a molten silver out from a forging furnace. In the undulated surface observed scores of "air-bubble" shaped objects with different dimensions.

As observed by naked eyes, the dark place on the lunar surface also looked a little dark in the field of telescope. Three patches, resembling snow-flake were observed, and from two luminous objects like beans, quaquaversal radiation was conspicuous.

The Jupiter when observed through the telescope looked like the full moon with four stars, two of which at the right hand side, one on the left and one on its top. The second named was too near and could only discern it with careful attention.

The Saturn in the field of telescope looked elongated, as if it had ears on both sides, separated by a crevice.

In the upper left hand side of "Bishuku" (lower part of Scorpius, environs of Kappa and Lambda) observed white object like a vapour and it was conglomeration of 23 stars (M. 6 or M. 7). The vignetted, whitish object observed in the constellation "Keishuku" (environs of Andromeda) had an interior nucleus of white colour. (M 31).

Kaiyosei (Mizar) in the Great Dipper was resolved into double stars, the bigger of which embracing small star nearby. In the constellation "Gyushuku" (Capricornus) a single star to the naked eye turned out to be a double star.

Number of stars is innumerable when seen with the aid of telescope.

In 10th Moon in 1795 Zenbei Iwahashi had come again with a larger telescope which resolved objects with more clearness. On seeing Jupiter three zonal stripes were seen and as for Saturn there was a ring that hung on it anew with left side top. When observed, Venus looked just like the Moon at its age of 12.

When directed the telescope to the most white part of the Milky Way, thousands of small stars looked like swarms of fire-flies in a silk-gauze cage.

The vignetted part in the constellation of "Kishuku" (Cancer, therefore Praesepe) was the congregation of 28 stars.

The above is the synopsis of descriptions by Nankei Tachibana and although the writer (Author of Kanden Jihitsu, Kohkei Ban) is quite ignorant of astronomical affairs, Zenbei Iwahashi may well be called as the most transcendent optician.

The First Maker of Reflector

It is admitted that some reflectors were imported in the middle stage of Tokugawa Shogunate very probably through the medium of Dutch Traders in Nagasaki. The writer found by chance, in an ocular shop in Kobe, the Gregorian signed G. Adams London, and this instrument is now dedicated to the Tokio Astronomical Observatory and, according to the proprietor, from whom the writer had purchased, it was bought by his grand father in Nagasaki.

Mr. K. Nakamura says that Gregorians originally imported exist at some places, yet he knows nothing as to the vernacular maker, save Tohbei Kunitomo.

At the end of last year Capt. Seiho Arima, I.J.N., who is the authority on ancient rifles and guns, discovered the fact that a superb reflector was made by a rifle-smith named T. Kunitomo and this was immediately informed to Prof. I. Yamamoto of Kioto Imperial University, who published it in Osaka Asahi Shimbun (newspaper).

Mr. S. Kanda of Tokio Astro-Obs. studied it also and published his report in the March number of Astro. Herald, and through his introduction the writer interviewed Capt. Seiho Arima, I.J.N., and obtained details which run as follows:

Tohbei Kunitomo is the 14th heir to the rifle-smith shop inaugurated by his ancestor, so that though empirical he had accumulated talents in forging and mechanism of high precision. About 14 years prior to his first venture in telescope-making, he saw Gregorian reflector in Astro-Obs. of Tokugawa Government in Yedo (Tokio), and with a vague memory then obtained he launched this new enterprise.

With the exception of the brass tube which he ordered from a brass-

smith in Nagahama every part was made all independently. It is noteworthy that the speculum is parabolic and not a mere concave which he completed instinctively and not from theoretical points of view. He made mirrors over and over again, started in 1832 and completed in 1833. It is said that in making speculum he studied the metal composition of old mirrors and his final decision reached was the ratio of copper 35%, zinc 65%. In grinding he employed an oval-shape grindstone.

The oculars were made of crystals, deliberately selected out of many (and idiosyncracy is found in the combination of 3 lenses, not conventional.*) To grind the small eyepiece lenses he used splitted bamboo with pine-tree rosin. There still exists diary in the house of Mr. Shigeru Kunitomo, fully illustrating series of processes which he used to attain the best result.

To cast the speculum disc every precaution was employed, so as to make disc free from distortion, making good use of wax with "Mitsu" for the mould, which had a ventilator at one end, presenting very peculiar yet striking appearance.

With the Gregorian he made thus, solar observation was carried out and the records of sun-spots from 1st Moon to middle decade of 2nd Moon next year are owned by Mr. S. Kunitomo in which sketches of spots are clearly seen. The total that he made exceeds more than a half-dozen, of which 2 or 3 were sold to the Feudal Lord of Kaga and others, at the time of great famine which occurred in 1835/6 lasting for 2 years, owing to his monetary stringency, in details at 70 "Ryo" and also in exchange for 40 bags of rice.

The inauguration of his first reflector making took place on 20th of 6th Moon, Tempo 3rd year, and it was solely for his own use in daily observation and not for commercial purposes, and yet he had to dispose of them at that critical juncture.

Daigyo Hazama's off-spring was also the astronomer of the time in Osaka, and Tohbei Kunitomo visited him to have his reflector tested, and to his joy it was proved to be better than the refractors which were then in existence.

Re Telescope

According to "Nagasaki Yawagusa" Vol. No. 5, edited by Nyoken Nishikawa (Astronomer), a telescope was made by Tohichi Ikushima, in Genna years, i.e., 1615 to 23.

It is said that in consideration of its startling efficiency in military purpose, Tokugawa Shogunate Government prohibited its manufacture outright. As for astronomical telescope, an optician in Nagasaki, Nizayemon Mori by name, succeeded in its first manufacture during Kioho Years, i.e., 1717 to 35.

*Through the courtesy of Mr. K. Nakamura of Kwasan Obs. the writer could examine the Gregorian under reference. Photograph of the parabolic speculum can be had from him if applied. In reality oculars that writer examined were composed of 2 convex lenses.

At the order of Eighth Shogun Yoshimune Tokugawa, he had made Sokugohyogi, a sort of transit instrument.

With reference to reflector there is a paragraph in Vol. No. 5 "Nagasaki Kenbunki" as under:—(With illustration of a Gregorian).

"This is European telescope, with which one can see distant object very closely, etc."

Whilst it is established fact that the first invention of magic glass was in 1608 by Jean & Hans Lipphersey, followed by Galileo's telescope next year, "Nanbanji Kohaiki" (The Story of Vicissitudes of Christian Church) edited by Dohjin Kiyu in Shoho Years,—Sixteen forties—professedly announces that European missionary presented numerous tributes to Nobunaga Oda, a grand hero in Fifteen Seventies and enthusiastic supporter of Christian Church, among which there was "Toh Megane"—Telescope.

Similar sort of manuscript is also found in the section for Ohuchi Yoshitaka, influential feudal lord in Suo province in the medieval stage, of "Zoku Honcho Tsukan" (Historical Reviews) compiled by Razan Hayashi in 1664, according to which Francisco Xavier, a Jesuit monk then residing in Japan, dedicated "Toh Megane"—Telescope—to the said lord.

In this instance however there is ample reason to believe that it was not telescope but eye spectacles, for it goes on to say:

"When used even the old can see things very clearly etc." Zenbei Iwahashi had made, as described previously, a good many telescopes, for some of which a stout bamboo was used in lieu of metals and wood-planks.

In Seventeen Sixties Kohjiu Yamaguchi, of Hiuga Province, compiled a book named "Karaki Zuihitsu," in which very interesting paragraph is found re telescope, which reads as follows:

"When Yieyasu Tokugawa—First Tokugawa Shogun—was at Suruga—i.e., after retirement—European donated glasses for solar and lunar observation. When directed at the sun it looked as if a glaring fire-ball with a strong heat, and in the case of the moon one felt coolness, etc."

"Chiuko Sohsho" says "In 5th Moon, 13th year of Kanbun, (i.e., 1673) an English vessel entered into the port of Nagasaki, and replenished provisions, in exchange of which crews handed 38 eye-spectacles and 1 telescope, etc."

In the 3rd Volume "Gayu Hanroku" edited by Ryuho Ohyeda in 1763, there is an interesting description re telescope, under the heading "Senri Kio," which runs as follows:

"European Telescope is made of ground and polished glass inlaid in a long tube, through which one can clearly see object at distance.

"When seen inversely object near-by looks as if at a remote place, etc."

"Kazan Kanwa Vol. No. 2" published in 8th Moon, 1741, by Takanao Ono, is another interesting item, dealing with danger of solar observation.

It gives out a caution to observer as under:

"Do not look at the sun through telescope. If dare to do so, one's eye will get scorched. Beware of this danger. When I was young I myself witnessed it. Solar observation will impair one's health, etc."

In Vol. No. 2 "Nagasaki Jitsuroku" (Report on status in Nagasaki) which was published in 10th year of Horeki, i.e., 1760, a noteworthy description is found which reads as under:

"In 1659, watch-posts were erected at Nomo and Noroshi Yawa, and officials stationed there watched the approach of foreign vessels with telescope, etc."

"Another watch-post was erected on the summit of a hill near Kosetoura, whither 3 telescopes were allotted."

Dutch Science and Astronomy

The systematical introduction of Dutch Science, originated by Konyo Aoki and popularized by Genpaku Sugita, Ryotaku Mayeno and others —the first named Chief Librarian of Tokugawa Shogunate and the latter two medical scientists—had assumed a great significance at the end of Eighteenth Century, and as its growth had much to do with advancement in astronomy, let a few lines be spared for its recognition.

Through political reasons Official Interpreters (of Dutch) stationed in Nagasaki whose position was hereditary were not allowed to read the books, and in 1744 when Konyo Aoki was sent thither to study Dutch at the injunction of the Eighth Shogun, Yoshimune Tokugawa, three young interpreters *viz.* Yeinoshin Motoki, Kohsuku Yoshio, and Zenzaburo Nishi, tendered petition to him to have that enactment abolished and soon it was granted at his suggestion.

It must be noted, however, that although study of foreign science was strictly prohibited soon after the Christian Rebellion in Kiushu (in the adjacent places of Nagasaki) western science crept into the country (though not significantly) through the medium of Dutch Officials and/or Physicians.

In 1736 (25 years after he assumed the post of Shogun) Yoshimune Tokugawa ordered the Dutch Official stationed in Japan to inaugurate Astronomical Literatures, which was promptly executed. On seeing its contents he was entirely complacent and it was through this motive that he selected Konyo Aoki (then his Librarian) and Hochiku Katsuragawa, (his Physician) who had aspiration, for the study of the Dutch.

In 1794 a renowned Dutch authority Gentaku Ohtsuki celebrated New Year's Day in accordance with Gregorian Calendar, calling it "Oranda Shogatsu"—Dutch New Year's Days—and this may be said to be the first application of western calendar in Japan.

Later he was promoted to the Translator of Tokogawa Shogunate Astro. Observatory (1811) and succeeded by Hansai Udagawa. These two were physicians by profession. Dutch-Japanese dictionary, containing 80,000 words, was compiled by Sanpaku Inamura, partly assisted by Hansai Udagawa, and the number of first edition issued was 30 in all.

Genkan Ohtsuki who occupied the post as Translator in the Astro-Obs. with his father, published book in 1816 called "Rangakuhan" which was the first grammar.

The astounding growth of Dutch science in this way had brought forth corresponding advancement in all lines and, to cite an instance, even electricity of low voltage was applied in massage treatment.

The fact that later when American Admiral Peary arrived at Uraga with his fleet with aim to conclude commercial treaty, Tatsunosuke Hori, interpreter, first hailed to them "I can speak Dutch" will amply illustrate how Dutch played a title role in foreign language.

Though not important from the standpoint of astronomy, here a short mention will be made of the heralds in French, German, and English languages for reference of the readers.

French

Hidetoshi Murakami, a physician of Dutch School, was desirous of reading a text book of chemistry and yet the one which he obtained was written in French. His comrade Shozan Sakuma, a heroic erudite of the time, had given him Franco-Dutch Dictionary. With this in hand and by his indefatigable effort he read it through in 16 months. In recognition of his merit in compiling Franco-Japanese dictionary (completed in 1852) he was later promoted to the Professor in Research Bureau of Foreign Affairs, of Tokugawa Government.

Besides dictionary he translated French Military Tactics and in 1885 was decorated by the President of France.

German

Ryokai Shiba, physician by occupation, went to Nagasaki and there he received tuition from Pompe. Japanese-German Dictionary was first compiled by him. The constitutional gift that he had in language was so astonishing that 5 months after he started study, in the course of conversation with German doctor Muller, he was questioned by him how long he had stayed in Germany. He understood 6 European languages, and was promoted to the assistant professor of the Tokio Imperial University later.

English

Complicated as it is, to define who was the first expert in this language is very obscure and yet, so far as investigation goes, English study was initiated in Nagasaki by Interpreters in 1809, and English grammar by Saburo Fujii in 1830-44.

Manjiro Nakahama who was rescued by American whaler whilst drifting in the expanse of the Pacific Ocean, spent many years in U.S.A. and was educated there by the courtesy of a wealthy American, and returned home, and it is said that it was he who translated the letter of President addressed to Tokugawa Shogun brought by Admiral Peary in 1853.

Dutch Expert, Tatsunosuke Hori, the Interpreter could also speak English to some extent and compiled Anglo-Japanese Dictionary.

S. S. "Shinrin Maru" (300 tons) commanded by Rintaro Katsu traversed the Pacific in 1858 which was epoch-making incident, M. Nakahama aboard as interpreter. This was the first Japanese navigation, under modern Nautical Astronomy that was tuitioned by Dutch Naval Officers, in Nagasaki in 1855.

Yukichi Fukuzawa, the Founder of Keio University later, was very fond of English and study was commenced with the aid of Anglo-Dutch Dictionary which he could hardly manage to obtain at the cost of five "Ryo" in Yokohama in company with his friend Keisaku Harada. He did not overlook chance of his being able to go to U.S.A. on board small vessel and volunteered himself as the servant of the Commander. He and M. Nakahama purchased Webster Dictionary in San Francisco. On his return his Dutch study was put to an end and devoted himself in English.

Afterward he was sent again to Europe and America. In U.S.A. he bought variety of text books in 12 crates, covering all lines of science. The price of Webster Dictionary then ruling in Yokohama was really 30 "Ryo" and that of a physical text book 10 "Ryo" however students of his school could get at 4 "Ryo" and 2 "Ryo" respectively, creating a sensation to book-sellers in consequence. His small school has grown into present Keio University.

Such being the case, he may be accepted as the consolidator of English, though not initiator, and subsequent rising tide in English overwhelmed the Dutch which was in vogue over four centuries.

Celestial Photography in Japan

In 1874, at the time of transit of the Venus that occurred on 9th December, Hikoma Uyeno photographed it in Nagasaki, at the request of French Government, and this is the first celestial photography. There is a memorial monument on the top of Kompira Yama.

Feudal Lord insisted Necessity of Photographic Observation to English Scientist

Nariaki Shimazu (died 1857), the influential Feudal Lord in Kiushu, in the course of interview with English Scientist, Dr. Grow, proposed the application of photography to celestial observation, and asked him if it was already realized in Britain. Dr. Crow was much amazed at the cleverness of this lord, by saying that even at Greenwich such was not in practice as yet.

This episode is depicted on page 329 of Dr. Grow's work: "Embassy to China and Japan."

(To be continued.)

Planet Notes for March, 1938

By R. S. ZUG

Note: Greenwich Civil Time is employed, unless otherwise stated. To obtain Eastern Standard Time subtract 5 hours; Central Standard Time, 6 hours; etc. The planetary phenomena are described as they are to be seen from latitude 45° N. The data are taken chiefly from the *American Ephemeris and Nautical Almanac*.

Sun. The positions of the sun for March 1 and March 31, respectively, are: $\alpha = 22^h\,45^m.2$, $\delta = -7°\,54'.8$; $\alpha = 0^h\,35^m.4$, $\delta = +3°\,48'.9$. The sun is in the constellation Aquarius until March 11, on which day it enters the constellation Pisces. Spring begins March 21, $6^h\,43^m$, at which time the sun reaches the vernal equinox. Values for the equation of time are as follows:

Date 1938	Equation of Time (Mean - Apparent) m s	Date 1938	Equation of Time (Mean - Apparent) m s
Mar. 1	+12 39	Mar. 17	+ 8 45
5	+11 51	21	+ 7 34
9	+10 54	25	+ 6 21
13	+ 9 52	29	+ 5 8
		Apr. 2	+ 3 56

Moon. Phenomena of the moon will occur as follows:

		h m
New Moon	Mar. 2	5 40
First Quarter	9	8 35
Full Moon	16	5 15
Last Quarter	24	1 6
New Moon	31	18 52
First Quarter	Apr. 7	15 10
Perigee	Mar. 11	8
Apogee	23	21

Mercury. Superior conjunction occurs March 8, 12^h, at which time Mercury becomes an evening star. The planet then moves rapidly eastward from the sun, and by March 31 has reached an elongation from the sun of about 18°. This will afford quite a favorable opportunity for identifying and observing the elusive planet Mercury. At sundown March 31 the planet will be situated almost due west, azimuth 92°, and at an altitude of about 18°. Greatest eastern elongation occurs April 2, 21^h, on which day the altitude of the planet at sundown will be about 19°. Because of the high inclination of the ecliptic circle to the horizon at sunset at this time of the year, this eastern elongation will constitute the most favorable opportunity for viewing Mercury during 1938. The elongation on April 2 is, however, near the lower limit for greatest elongation of Mercury (greatest elongations vary from 18° to 28°), perihelion passage having occurred March 24. On March 31 the stellar magnitude of Mercury will be 0.0.

Venus. Venus is now an evening star. On March 1 it will set only a half hour after the sun, but by March 31 its altitude at sunset will be 12°, and it will remain in view for an hour after sundown. By the end of March it will therefore be a conspicuous object in the early evening sky. An interesting planetary configuration involving Venus, Saturn, and Mercury, may be studied shortly after sundown on March 17, by observers favored with clear western horizon. Venus will be situated at the right angled apex of an isoceles triangle of planets, and

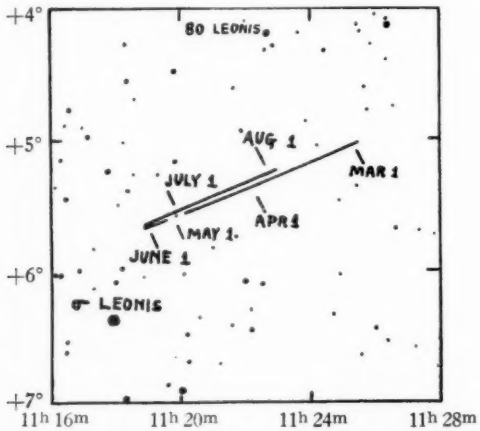
above Saturn and Mercury, which two, respectively, will mark the left and right extremities of the hypothenuse. At sunset, Saturn and Mercury will be 8° above the horizon, and will be separated by an angle of about 2°.

Mars. Mars continues as an evening star, with diminishing elongation. On March 31, the planet will be 35° east of the sun, close to the ecliptic circle, and 208 million miles from the earth. Mars passed the ascending node March 1.

Saturn. Saturn is poorly placed for telescopic observation, but continues as an evening star until conjunction with the sun March 29.

Uranus. Uranus can still be observed in the evening sky, its position March 1 being $\alpha = 2^h\,32^m.7$, $\delta = +14°\,36'$. By March 31 its altitude at sundown will be only 30°, so that observing of this planet will be about over for a while. On March 28, 22^h, Mars in its eastward motion passes 44′ to the north of Uranus.

Neptune. Opposition for Neptune occurs March 11. To facilitate observation of this planet, the accompanying chart has been prepared, illustrating the path of Neptune relative to the surrounding star field. The chart shows one naked-eye star, σ Leonis, magn. 4.13. Another of the stars shown, 80 Leonis, magn. 6.36,



THE PATH OF NEPTUNE AMONG THE STARS.

should be possible of easy identification with the aid of a small telescope. The chart is arranged to correspond with the field of view of an inverting telescope. For comparison with the telescopic field of view, the chart should be held with its "upward" direction oriented toward the north celestial pole. The star background of the chart has been copied from the B.D. (Bonn Durchmusterung) star charts, with allowance for precession, and the smallest dots represent in general stars of from 9.5 to 10.0 magnitude. All of the stars shown should be distinguishable on a moonless night with the aid of a telescope of 3-inch aperture. The stellar magnitude of Neptune at opposition is 7.7.

Occultation Predictions

(Taken from the *American Ephemeris*)

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.

Date 1938	Star	Mag.	IMMERSION Greenwich C.T.	IMMERSION *a*	IMMERSION *b*	IMMERSION Angle E from N	EMERSION Greenwich C.T.	EMERSION *a*	EMERSION *b*	EMERSION Angle E from N
			h m	m	m	°	h m	m	m	°
Mar. 6	π Ari	5.4	22 50.4	—1.5	+0.9	47	23 53.5	—1.1	—2.1	289
9	BD+20°1105	5.9	21 44.4	—1.6	+1.5	71	22 58.8	—1.9	—0.7	292
10	χ^2 Ori	4.7	5 40.5	+0.1	—1.4	108	6 32.2	+0.3	—1.2	273
12	1 Cnc	6.0	2 37.3	—1.4	—1.5	121	3 50.6	—1.3	—1.4	283
13	60 Cnc	5.7	3 46.9	—1.2	—1.7	128	4 57.8	—1.3	—1.5	284
19	40 H.Vir	5.1	5 26.9	..	..	176	6 5.8	..	..	233
21	10 G.Sco	5.9	7 13.3	—2.0	+1.0	84	8 37.1	—1.8	—0.6	302
23	58 Oph	4.9	9 13.8	..	..	30	10 2.9	..	..	327
24	108 B.Sgr	6.5	9 33.1	—2.0	+0.8	94	11 2.1	—2.1	+0.6	250
OCCULTATIONS VISIBLE IN LONGITUDE +91° 0′, LATITUDE +40° 0′.										
Mar. 10	χ^2 Ori	4.7	5 46.0	0.0	—2.1	133	6 34.9	—0.3	—0.8	250
12	1 Cnc	6.0	2 16.1	—1.3	—2.6	150	3 17.9	—2.4	+0.7	250
13	60 Cnc	5.7	3 31.6	—0.8	—3.2	163	4 25.5	—2.5	+0.7	248
20	25 Lib	6.0	11 57.7	—1.7	—1.8	123	13 8.0	—1.0	—0.9	251
21	10 G.Sco	5.9	6 44.2	—1.0	+0.6	112	8 3.2	—1.6	+0.6	280
23	58 Oph	4.9	8 26.3	—1.8	+2.4	56	9 32.7	—1.3	—0.2	311
24	108 B.Sgr	6.5	9 3.7	—1.1	+0.8	109	10 20.6	—1.9	+1.5	246
OCCULTATIONS VISIBLE IN LONGITUDE +120° 0′, LATITUDE +36° 0′.										
Mar. 7	ρ Ari	5.6	2 4.5	..	..	19	2 44.2	..	..	317
10	68 Ori	5.7	9 27.4	..	..	182	9 35.3	..	..	200
12	30 B.Cnc	6.1	9 34.1	0.0	—2.3	147	10 20.5	—0.4	—0.8	255
13	α Cnc	4.3	3 38.1	—1.9	+0.3	101	4 56.5	—1.7	—1.2	307
13	κ Cnc	5.1	9 35.8	—0.7	—1.5	109	10 37.0	—0.2	—1.8	300
14	14 Sex	6.3	12 11.9	—0.4	0.0	55	12 41.8	+0.3	—2.9	350
18	ι Vir	5.6	8 3.5	—2.5	+1.1	83	9 12.0	—1.1	—1.9	334
20	25 Lib	6.0	11 7.8	—1.8	—1.6	144	12 21.4	—2.6	+0.2	249

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result in degrees, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

Asteroid Notes

By HUGH S. RICE

Concerning the Reinmuth Object or planet 1937 UB, there is little further news to report at the present time. Unfortunately there were only a few observations of this asteroid secured, which is distressing, inasmuch as it approaches the earth so closely. In the middle of February it is in Sagittarius and of magnitude 19.4, and probably beyond the reach of any telescope except the 100-inch. No observations have been published lately, and it is feared that the asteroid is temporarily lost. The discoverer, Dr. K. Reinmuth, has named the object *Hermes*.

Since this name is identified with Mercury, which is the nearest planet to the sun, the name seems appropriately applied to a minor planet nearest the earth. Meyer of Rutherford has calculated (with the data so far available) that the diameter of Hermes is about ½ mile, making it of the same order of size as Adonis. Crommelin states that the diameter is probably less than a mile.

Eros has been observed to follow its predicted path at this apparition, with very small residuals. Vesta in 1938 will become just visible to the naked eye in May. In a small telescope it can be followed in February with the aid of a star chart as follows: position on February 1, 0^h U.T. is about 4½° northwest of γ Librae; on March 2, 1° south of ξ Scorpii. The magnitude during this interval is from 7.3 to 6.9. It does not become stationary until April 10.

During the year, Ceres comes to opposition in November, Pallas in September, and Juno in May. Juno is in Ophiuchus this month passing north of ρ Ophiuchi on February 10, but the magnitude is nearly 11. The following ephemerides cover the remaining best asteroids to observe during the February-March period [note the new equinox]. They were computed by the Astronomisches Rechen-Institut, at Dahlem, Germany.

EPHEMERIDES OF MINOR PLANETS. FOR 0^h U.T. EQUINOX OF 1950.

22 KALLIOPE (9^M.7)

		α h m	δ ° ′
Jan.	22	10 9.8	+31 54
	30	10 3.9	+32 57
Feb.	7	9 56.9	+33 51
	15	9 49.3	+34 32
	23	9 41.9	+34 59
Mar.	3	9 35.2	+35 10

51 NEMAUSA (9^M.5)

		α h m	δ ° ′
Feb.	15	11 20.3	− 1 3
	23	11 15.2	+ 0 9
Mar.	3	11 9.0	+ 1 33
	11	11 2.4	+ 3 3
	19	10 56.3	+ 4 33
	27	10 51.0	+ 5 57

14 IRENE (8^M.7)

		α h m	δ ° ′
Feb.	23	11 51.5	+18 11
Mar.	3	11 46.0	+19 15
	11	11 39.3	+20 15
	19	11 32.5	+20 57
	27	11 26.1	+21 20
Apr.	4	11 20.7	+21 25

Hayden Planetarium, American Museum of Natural History,
New York City, January 19, 1938.

Comet Notes

By G. VAN BIESBROECK

As the year opens there is a conspicuous absence of comets known to be observable. No reports have been received as yet of further observations of PERIODIC COMET ENCKE in the southern hemisphere; because of its nearness to the sun it remains rather difficult to reach.

Large instruments may still record the slowly receding but little changing COMET 1935 *d* (VAN BIESBROECK) moving at high declination in the constellation of Cassiopeia.

Efforts should be continued to locate PERIODIC COMET 1927 VI (GALE) which, according to the ephemeris given on p. 59, should soon be in reach in the morning sky. Continued cloudy weather has hampered the search at the Yerkes Observatory.

Williams Bay, Wisconsin, January 19, 1938.

METEORS AND METEORITES

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

The table of rates which follows is printed for several reasons, though the number of such tables in these Notes has steadily decreased. In the first place, it is the most effective way of showing our appreciation for the work of some of our groups, as for instance, this time the Oregon Group, The Amateur Astronomers Association of New York City, and the Louisville Astronomical Society. These reports are mostly counts of hourly rates, without plotting. Also it gives the clearest data on the richness of certain streams. Nevertheless it has ceased to be practicable to publish all such data, received every year, so a certain selection has to be made.

Observer and Station	Date 1937	Began	Ended	Total	Met.	F.	Rate
M. A. R. Khan, Begumpet, India	July 27	20:30	21:30	60	6	0.5	6.0
(Times by Khan are all U.T.)	31	21:00	22:00	60	14		14.0
	Aug. 3	21:15	22:00	45	8		10.7
	4	21:00	22:00	60	10		10.0
	11	18:30	19:30	60	14	0.2	(14)
	12	21:15	22:45	90	39	0.5	26.0
	13	21:00	22:00	60	12	0.3	(12)
	15	21:15	22:15	60	12		12.0
	Sept. 9	19:00	20:30	90	11		7.3
	13	22:00	22:30	30	6	0.5	12.0
(5 Orionids)	Oct. 10	19:30	20:30	60	27		27.0
	11	20:00	21:00	60	12		12.0
(4 Orionids)	12	21:00	22:00	60	14		14.0
(11 Orionids)	18	20:15	21:15	60	11		11.0
(13 Orionids)	19	21:30	22:30	60	13		13.0
(17 Orionids)	20	20:15	21:15	60	17		17.0
	29	19:40	21:00	80	37		27.8
	30	18:30	19:30	60	12		12.0
Katherine Martin, Pierre, S. D.	Aug. 12	12:00	14:15	120	97		48.5
Ruth Martin, Pierre, S. D.	12	12:00	14:15	120	108		54.0
Agnes O'Keeffe, Pierre, S. D.	12	12:00	14:15	120	115		57.5
Florence Jones, Hines, Oregon	11	14:00	15:00	60	55	1.0	55.0
Marjory Jones, Hines, Oregon	11	14:00	15:00	60	84	1.0	84.0
	15	13:45	14:15	30	12	0.9	24.0
Fern Thompson, Eugene, Oregon	10	12:25	14:25	120	53	1.0	26.5
	11	12:25	13:45	80	43	1.0	32.2
	12	12:30	14:15	105	31	0.9	17.7
Bette J. Thompson, Eugene, Oregon	11	12:25	13:45	80	35	0.8	26.2
	12	12:30	14:15	105	58	0.8	33.1
Harryette Thompson, Eugene, Oregon	10	12:25	14:25	120	42	0.8	21.0
	11	12:25	13:45	80	45	0.8	33.8
	12	12:30	14:15	105	52	0.8	29.7
Hope S. Pruett, Eugene, Oregon	10	10:15	12:00	105	24	0.8	13.7
	11	10:00	12:00	120	72	0.8	36.0
	12	9:45	12:15	150	67	0.8	26.8
J. Hugh Pruett, Eugene, Oregon	10	10:15	11:45	90	23	0.8	15.3
(Telescopic)	11	9:45	10:15	30	7	0.8	
P. O. Parker (9 Leonids)	Nov. 13	12:18	15:40	202	26	0.8	7.7
Ooltzwah, Tennessee	21	6:50	8:10	80	6	0.1	
Prof. R. G. Clarke and Students—							
Newton Obs., Meadville, Pa.	Aug. 11	11:25	15:00	205	162		
	12	11:30	14:00	150	135		
Conneaut Lake, Pennsylvania	12	11:30	14:00	150	108		

Observer and Station	Date 1937	Began	Ended	Total	Met.	F.	Rate
Mary L. Jewett, Grandview, Tenn.	Aug. 10	12:00	13:30	90	29	0.8	19.3
	Nov. 12	13:00	15:32	92	12	0.8	7.9
	13	14:20	15:20	60	13	1.0	13.0
	14	15:30	16:00	30	9	1.0	18.0
L. L. Doolittle, Stony Creek, Conn.	Dec. 3	11:00	13:00	120	37	1.0	18.5
	15	15:30	16:30	60	27	1.0	27.0
J. Leerman, Baltimore, Maryland	Dec. 11	14:00	16:00	120	14		7.0
	12	12:40	14:10	90	21		14.0
	13	14:30	15:40	70	22		18.8
J. S. Andrews, New York City	Nov. 14	11:30	16:40	310	11	0.2	
M. Vick, Louisville, Kentucky	Dec. 10	11:00	14:00	150	74		29.6
W. L. Moore, Louisville, Kentucky	10	11:00	14:00	120	45		22.5
B. McCrocklin, Louisville, Kentucky	10	11:00	14:00	150	56		22.4
E. Montgomery, Louisville, Kentucky	10	11:00	14:00	150	57		22.8
J. Burlee, Louisville, Kentucky	10	11:00	14:00	150	58		23.2
J. R. Vincent, Louisville, Kentucky	10	11:00	12:30	90	31		20.7
B. Gibson, Louisville, Kentucky	10	11:00	12:30	90	24		16.0
B. Mathes, Louisville, Kentucky	10	11:00	12:30	90	24		16.0
M. J. Wells, Louisville, Kentucky	10	11:00	12:30	90	20		13.3
Av. rate for Louisville group (9 obs.)							20.7
E. Loreta, Bologna, Italy (47 Gemin.)	Dec. 13	15:00	17:15	115	93		48.4
V. Anyzeski, New Haven, Conn.	Dec. 7	11:00	12:35	95	16	0.9	10.1
T. K. Tomkins, North Hills, Pa.	Dec. 3	11:00	13:00	120	17	1.0	8.5
Amateur Astronomers Association of New York City:							
Clara Hicks, Hewlett, L. I., N. Y.	Dec. 10	12:30	13:30	60	10	1.0	10.0
Clara Hicks, Tenefly, N. J.	11	12:30	15:20	120	33	1.0	16.5
Harry Kuris, Hewlett, L. I., N. Y.	10	12:30	15:00	120	41	1.0	20.5
H. B. Ransome, Hewlett, L. I., N. Y.	10	12:30	15:00	120	29	1.0	14.5
I. Grossman, Hewlett, L. I., N. Y.	10	12:30	15:25	120	28	1.0	14.0
C. Grosswendt, Hewlett, L. I., N. Y.	10	14:30	15:30	60	21	1.0	21.0
W. Howland, Tenefly, N. J.	11	12:30	15:20	120	18	1.0	9.0
M. Rose, Tenefly, N. J.	11	12:30	15:25	120	11	1.0	5.5
C. Trevasani, Tenefly, N. J.	11	12:30	15:20	120	27	1.0	13.5
F. Varella, Tenefly, N. J.	10	12:30	13:30	60	9	1.0	9.0

Attention should be called to the further installment, Part 6, of the work of the Harvard Arizona Meteor Expedition, just published by Öpik in *Annals H.C.O.*, Vol. 105, pages 549-600. This section is taken up with an exhaustive analysis of their meteor heights. It is far too complicated to review without serious and prolonged study, so further remarks will be withheld for the present, except to say that nothing in it changes my opinion that the use of reticles in meteor observing is not conducive to high accuracy.

The Quadrantids in 1938.—Usually these meteors are neglected, due mostly to the cold nights when they appear. Much to my surprise four observers have already sent in their records. The tabular results follow.

Observer and Station	Date 1938	Began	Ended	Total	Met.	F.	Rate
Anyzeski, V., New Haven, Conn.	Jan. 3	11:30	15:00	210	23	1.0	6.6
Neale, J. J., New Haven, Conn.	2	13:15	14:45	90	21	0.9	14.0
	5	12:42	14:30	108	8	1.0	4.4
Stone, W. R., Santa Barbara, Calif.	2	10:30	15:35	305	43	1.0	8.5
	3	11:30	14:30	180	8	1.0	2.7
Loreta, E., Bologna, Italy	2	14:00	14:55	50	30	1.0	36.0
	3	15:00	15:55	50	17	1.0	20.4

W. R. Stone is the only one whose maps have yet arrived; Loreta mostly counted, not plotting on account of extreme cold. Stone's plots are largely upon our map No. V, which does not contain the position of the supposed radiant as

given in Denning's G. C. (R.A. 231°, Decl. +51°). However, I find three strongly defined radiants on January 2 and one on January 3. Four meteors on first date would bisect Denning's radiant but, dut to difficulty in transferring from one map to the adjacent one and resulting errors, it was not attempted. One meteor on second date would do the same. Stone's radiants follow.

A.M.S. No.	1938	α	δ	Meteors	Remarks
2975	Jan. 2.9	165°	+58°	9+	Good
2976	2.9	197	47	8	Good
2977	2.9	212	60	5	Long paths, Good
2978	3.9	201	56	4	Good

The lack of agreement of all these four radiants with Denning's position inspired me to examine our A.M.S. card file of about 2000 radiants. I find the following 10 for the appropriate dates which fall somewhere near this region.

A.M.S. No.	January	α	δ	Meteors	Observer	Remarks
1	1905 1.80	199°.4	+47°.6	3	C.P.O.	
916	1916 3.92	203	49	6	G.H.B.	Poor
2596	1931 2.9	206	62	1	G.W.R	Sta.
1426	1921 2.89	210	51	14	R.M.D.	Good
2501	1931 1.96	218	41	8	L.LaP.	Good
1432	1920 2.94	218.5	44.4	4	C.P.O.	Good
1665	1928 3.8	224	53.5	10	C.P.O.	Good, large area
2779	1933 2.96	226.5	43	10	F.W.S.	Good
2918	1936 1.0	230	49	6	H.I.	Good
969	1916 3.92	240	32	7	G.H.B.	Fair

The only conclusion one can come to is that either these radiants were very poorly observed or that the stream is so scattered that a sharp center may not be expected, year after year, in the same position. The latter is the more probable explanation. But in any case it shows the great need for concentrated study on these meteors. Loreta reported that on the first night 16 of the 30 meteors and on the second 5 of the 17 were "Bootids" another name for the Quadrantids. He said none of them had trains; on the contrary Stone reported several as having fine ones. All our members are urged, for some years to come, to get all possible data upon this interesting system.

Eleven other radiants recently deduced from 1937 observations follow.

A.M.S. No.	1937 G.M.T.	α	δ	Meteors	Notes
2979	Oct. 11.3	86°.2	12°	3	
2980	Oct. 18.3	91.2	15		
2981	Oct. 20.3	93.8	15		
2982	Oct. 29.3	111.2	48	several	
2983	Oct. 16.8	51	43	8	Good
2984	Oct. 20.8	88.5	14.5	5-6	Fair
2985	Oct. 20.8	98	16	8-10	Good
2986	Oct. 24.7	100	16	5	Good
2987	Oct. 30.7	20	52	5	Fair
2988	Nov. 6.6	48	15	5	Good*
2989	Nov. 7.8	66	18	4	Good

*Bright yellow or red meteors, long paths; trains.

The first four were sent to me, as derived by Prof. M. A. R. Khan; 2983-2988 inclusive are from maps of V. Anyzeski, and 2989 from those of J. J. Neale, as derived by me.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1938 January 18.

The Resistance of the Air to Meteors

(Second Paper)

By C. C. WYLIE

In a recent paper (Contribution Number 7, page 231; POPULAR ASTRONOMY, **44**, page 281, 1936) the equation for a meteor in vertical fall was given as

$$M(dV/dt) = Mg - R$$

The term $M(dV/dt)$ represents the rate of loss of momentum by the meteor, g the acceleration of gravity, and R the rate of transfer of momentum to the air. The term R was given as

$$dm/dt = \pi r^2 G e^{-bh} (dh/dt)^2 \qquad (1)$$

If we use σ for the density of the air and assume that the fall is not necessarily vertical, we can write for the resistance of the air

$$M(dV/dt) = G\pi r^2 \sigma V^2 \qquad (2)$$

Professor Dunham Jackson published in 1919 a paper on the resistance of the air to projectiles, entitled "The Method of Numerical Integration in Exterior Ballistics" (War Department, Document Number 984). His equation for the resistance of the air may be put in the form

$$dV/dt = G(V)H(y)d^2iV/w \qquad (3)$$

The quantities $G(V)$ and $H(y)$ are tabulated, and i depends on the shape of the projectile. The quantity d is the diameter in inches, V is the velocity in meters, and w is the weight in pounds.

Rewriting equation (2) we obtain

$$dV/dt = G\pi r^2 \sigma V^2/M \qquad (4)$$

where r is the radius in centimeters, σ is the density of the air, V is the velocity in centimeters per second, and M is the mass in grams. Equating the values of dV/dt from equations (3) and (4), G can be expressed in terms of $G(V)$, V, and i. The result is as follows:

$$G/i = 6.923 \times 10^4 \times G(V)/V$$

The quantity $G(V)$ is taken from the tables with the argument $V^2/100$ where V is in meters. The V in the denominator is expressed in centimeters. The tables in Jackson's paper give the value of $G(V)$ for velocities from zero to 1800 meters per second. Using these tables the value of G/i was computed for certain velocities, as follows:

V(meters)	100	300	600	900	1200	1500	1800
G/i	.1035	.1477	.2919	.2468	.2345	.2325	.2321

The value of G/i increases rather sharply to about the velocity of sound and then decreases, approaching asymptotically a value much higher than that below the velocity of sound. It appears that for velocities much higher than those in the tables, the value of G/i is about 0.232.

Let us assume that at the velocities of meteors $G/i = 0.232$. If we knew the value of i, we could solve for the coefficient G. For the better shells used during the World War, the value of i was about 1/2. For the poorer shells, the value was about unity. Presumably, most meteors have a value of i higher than for even the poorer shells used during the World War.

Dr. Paul S. Epstein published in 1931 (*Proceedings National Academy of Science*, **17**, 532) a paper "On the Air Resistance of Projectiles." On reasonable

assumptions, and using only two dimensions, he derived equations for the resistance of the air. Extending his equation to three dimensions one obtains

$$M(dV/dt) = 1/3\pi r^2 \sigma V^2 \qquad (5)$$

Comparing equations (2) and (5) we obtain

$$G = 1/3 \qquad (6)$$

Comparing this value of G with the value of G/i obtained from Jackson's paper, we obtain $i = 1.44$.

SUMMARY

In an earlier paper we published a formula[1] for the resistance of the air to meteors which included an empirical coefficient G. From the tables in Jackson's paper this empirical coefficient is evaluated. The resulting value for G includes an i depending on the shape of the projectile, or meteor.

From Epstein's paper, a formula is derived which gives $G = 1/3$. Assuming this value of G, the coefficient i in Jackson's paper is 1.44. This is higher than the i for even the poorer projectiles used during the World War, but it does not appear unreasonable. Let us assume tentatively that

$$G = 1/3$$

University of Iowa, January 19, 1938.

[1] A third paper giving a more general solution of the problem of the resistance of the air to meteors has been prepared and will probably appear next month.

Contributions of the Society for Research on Meteorites

Edited by FREDERICK C. LEONARD,
Department of Astronomy, University of California at Los Angeles

President of the Society: H. H. NININGER, Colorado Museum of Natural History and American Meteorite Laboratory, Denver

Secretary of the Society: ROBERT W. WEBB, Department of Geology, University of California at Los Angeles

A Photograph of a Nearly Stationary Meteor

By WALTER W. ZIMMERMAN,
Department of Astronomy, University of California at Los Angeles

The accompanying photograph (Fig. 1) is the only one which the writer has even seen of the comparatively rare phenomenon known as a "stationary" meteor. The rarity of the picture will be appreciated when it is realized that in order to obtain such a photograph, the observer and his camera must be in a direct line with the meteor's path through the earth's atmosphere. Evidently the chance of his being in such a position with a camera exposed to the proper part of the sky at the right time is exceedingly small.

This photograph was secured by the writer, a member of the Society for Research on Meteorites, on 1938 January 3, while he was attempting to photograph meteors of the Quadrantid shower. Although many members of this shower were visible between January 2, $23^h\,00^m$, and January 3, $2^h\,15^m$, none succeeded in registering on the photographic film. The nearly stationary meteor was not a member of the Quadrantid shower, but was of the non-shower or "sporadic" variety. This

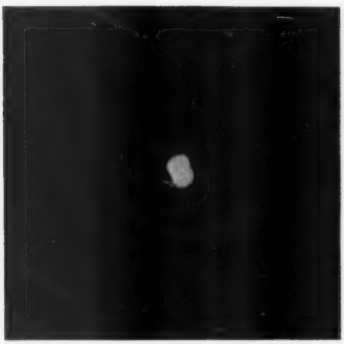


FIGURE 1
A PHOTOGRAPH OF THE NEARLY STATIONARY METEOR OF 1938 JANUARY 3
(The image of the meteor appears between the trails of 76 Draconis, above, and 75 Draconis, below.)

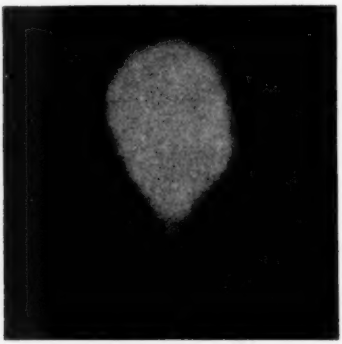


FIGURE 2
AN ENLARGEMENT OF THE IMAGE OF THE METEOR APPEARING IN FIGURE 1

meteor appeared January 3, $00^h\,11^m$ P.S.T., in the constellation Draco, between the sixth magnitude stars 75 and 76 Draconis, and was visible for about $1\frac{1}{2}^s$. Fig. 1 is an enlarged portion of the original negative and shows the meteor below the trail of 76 Draconis and above that of 75 Draconis. The coördinates of the meteor

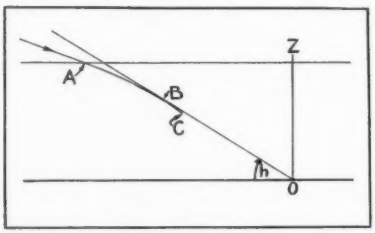


FIGURE 3
A DIAGRAM OF THE PROBABLE PATH OF THE "STATIONARY" METEOR OF 1938 JANUARY 3

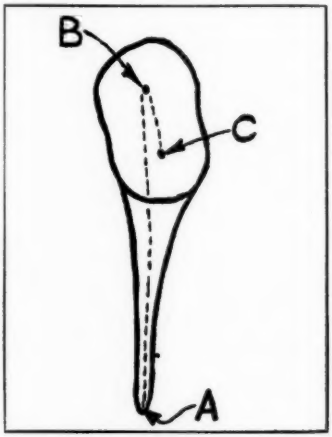


FIGURE 4
KEY DIAGRAM TO FIGURE 2
(The trail is here represented as it appears on the original negative—somewhat longer than in the reproduction, Fig. 2.)

were $\alpha = 20^h\,35^m$, $\delta = +81°\,40'$. It was of magnitude zero, was yellowish-orange in color, and appeared to move upward a very short distance and then to remain nearly stationary. The photograph seems to indicate, however, that the meteor did not remain absolutely stationary, but actually *reversed* its apparent direction before it finally disappeared! Fig. 3 exhibits clearly how this apparent reversal of direction would be possible. Let the curve *ABC* represent the actual path of the meteor and the straight line *OB* the line joining the observer, *O*, to the point of maximum altitude, *h*, of the meteor's path. The meteor began to be visible at the point *A*. As it progressed along the slightly curved path *ABC*, it appeared to the observer to be moving toward his zenith, *Z*, until it reached the point *B*. There it appeared stationary for an instant and then moved downward to the point *C*, the lower limit of its actual path. At the point *B*, accordingly, the apparent reversal of direction occurred. Fig. 4 shows diagrammatically the parts of Fig. 2 (a still greater enlargement of the original photograph) which seemingly correspond to the points *A*, *B*, and *C* of Fig. 3.

The camera employed was equipped with an *F*. 4.5 lens, having a focal length of 105 mm., and was loaded with Eastman Supersensitive Panchromatic roll film. In the course of the thirty minutes during which the film was exposed, the lens became very slightly fogged. This fact accounts for the decrease in the brightness of the star trails toward the end of the exposure. Had it not been for this effect, the meteor would probably have left a stronger impression on the film than it did. The observing station from which the photograph was obtained was situated approximately three miles northwest of the Mt. Wilson Observatory, on the Angeles Crest Highway.

A Reply to Dr. L. J. Spencer's Paper on "Meteorites and the Craters on the Moon"

By H. H. Nininger

In this paper* it is pointed out that meteorite craters are no longer looked upon as mere impact craters but rather as craters of explosion produced by the sudden transformation of the kinetic energy of the invading meteorite into heat. It is pointed out also that, on the moon, where there is no atmosphere, the majority of meteorite craters should have been formed by stony meteorites which, on colliding with the earth's atmosphere, are disrupted and fall as showers of fragments.

The bright radiating streaks or "rays," extending out from a few of the lunar craters, are explained as composed possibly of shining particles of metal which resulted from jets shot out immediately after the impacts. Such shining particles have been found in the silica glass associated with the Wabar craters in Arabia. It is noted that these rays characterize about the same percentage of the lunar craters as do iron meteorites, of the witnessed meteoritic falls on the earth.

The "seas" or *maria* on the moon are explained as lava flows from fissures which have been formed later than the majority of the lunar craters but earlier than the few very perfect craters which mar the surfaces of the "seas." Attention is called to the fact that, though atmospheric erosion is lacking on the moon, as has long been recognized, yet the breaking up of lunar rocks by the violent changes in temperature which take place there must be a very effective agency in modifying

*Published in *Nature*, **139**, 655, Apr. 17, 1937, and read at the joint symposium of the S.R.M. and Section E of the A.A.A.S. on "Meteorite Craters," at the Fifth Annual Meeting of the Society in June, 1937.

the appearance of the moon's surface features.

A serious objection to the meteoritic explanation of the lunar craters has always been their almost uniformly circular outline as viewed from our planet. Recently Dr. L. J. Spencer has met this objection by explaining that all meteorite craters are explosion craters and "not craters of impact or percussion." As such he contends that the form of the lunar craters should be always approximately circular, regardless of the angle at which the meteorites by which they were formed struck the moon's surface. He argues that all meteorite craters on the earth also may be expected to exhibit approximately circular outlines. The writer believes that this contention is sound as regards the craters on the moon, but that when applied to the earth some important modifications are necessary.

Dr. Spencer admits only five locations where "undoubted" meteorite craters have been found on the earth. These are: Meteorite Crater, Arizona; Odessa, Texas; Henbury, Australia; Wabar, Arabia; and Campo del Cielo, Argentina. He has objected to the Haviland, Kansas, crater on the grounds that: first, it is not large enough, although he has repeatedly referred to crater No. 13 of the Henbury group, which is 33⅓% smaller than the Haviland crater; second, that no silica glass has been found there; third, that it contained meteorites; he says, "the best behaved meteorite craters contain no meteorites"; and, fourth, that it was not circular. Though I have the highest regard for much of Dr. Spencer's writing on meteorite craters, he here falls sadly short of his usually high standard by adopting an arbitrary definition of the term *meteorite crater*—a term which has been in use for many years. The second which he names in his list of proved craters fails to fulfill the definition, and another one does so only by his acceptance of second-hand information concerning it. He definitely excludes the "Carolina Bays" from his list of craters, when no adequate investigation has been made regarding them. He is justified in regarding them as doubtful, but not as disproved. As for the Haviland crater: it supplies our most complete factual evidence of the nature of these most important features of the earth's surface. The fact that it was found to be elliptical instead of circular would seem to warrant his special consideration of it; but he completely rejects it. As a matter of fact, we have yet to prove whether or not the craters of Arizona, Texas, Australia, and Arabia, as well as those of Argentina, may or may not contain a distribution of meteorites similar to that found in the Haviland crater. However, we admit that the surface evidence is in favor of a circular rather than an elliptical outline for their meteorite horizons. Certainly no work so far done on any of these craters precludes the possibility or even the probability that they conceal a generous distribution of meteorite fragments.

Now let us consider the contention that all meteorite craters on the earth should be circular in outline. As we have pointed out, the circular form of those found on the moon is what would logically be expected. Both Gifford and Moulton long ago demonstrated mathematically that the accepted interplanetary velocities of meteorites were sufficient to explode those bodies upon their collision with a solid body and so to produce craters similar to those formed by the exploding of charges of nitroglycerin. Even after a considerable reduction in speed due to aërial friction, it can be demonstrated that such an explosion would occur. This conception doubtless describes the results which are to be expected in cases where the encounter takes place at a considerable angle with the horizontal. However, by the law of averages, we may expect that a considerable percentage of the encounters will take place near the periphery of the aërial envelope at angles approaching zero. In such cases the invading mass will follow a course closely approximating one

parallel to the curvature of the earth's surface. This condition may require that the meteorite pass through thousands of miles of atmosphere instead of only a few hundred. The great meteoric procession of February 9, 1913, was an example of such an encounter. In this instance a procession of meteorites entered the earth's atmosphere probably somewhere over the northern Pacific Ocean. By the time they had reached a point over western Saskatchewan, Canada, their struggle with the aërial blanket began to produce a meteoric display described by observers as like bright "shooting-stars." Later this display grew brilliant and dazzling. Over Ontario and Quebec violent detonations were heard and earth tremors felt. The procession continued out over the Atlantic Ocean, where it was noted from ships, and finally disappeared far to the east of the Bermuda Islands, after having penetrated some 6000 miles of atmosphere after it began to attract attention. Whether the meteoritic material was entirely consumed in the atmosphere or whether it was finally swallowed up by the sea can never be known. According to W. H. Pickering, the course of this meteoric procession nearly paralleled the curvature of the earth. Where such a condition exists, it is evident that the lithosphere may be encountered at a very low angle and at a comparatively low velocity; in fact the velocity of the meteorite might be reduced to a value approximating the landing velocity of a large artillery projectile. Considering these possibilities, we may have a wide range of applicable results. We may conceive of a situation in which a very large mass would produce no explosion at all. On the other hand, we may have a situation in which only a few hundred miles of air are encountered and the invading mass is reduced largely to vapor.

Surveying our extremely meager fund of factual information, we are surprised at how wide a range of impact velocities seems to be indicated. At the Wabar craters, according to Dr. Spencer, we have evidence of an extremely violent encounter which resulted in a seething pool of boiling silica and iron and the spraying out of molten silica bombs in which were trapped abundant spherules of condensed iron vapor. The walls of the craters are said to be glazed, and abundant fused country rock litters the landscape. Little meteoritic iron is found. The craters at Henbury, Australia, supply less evidence of violent heat: some silica glass, some fused country rock, and a much greater amount of meteoritic iron are found there. At the Arizona crater we have evidence of a much larger meteorite's having struck at not so high a velocity. There is some fused silica but none so completely glassy as the best examples from Henbury. Meteoritic iron is more abundant and there is good reason to believe that complete excavation would reveal enormous quantities of fragmentary iron. The Odessa crater shows evidence of a violent explosion that reduced the meteorite largely to dust, which may yet be recovered in an oxidized form from the rim of the crater. Silica glass is of course lacking, since the impact occurred in a limestone formation. In the case of the Haviland crater, there was evidently an explosion, but one which did not completely destroy the invader; it was reduced to dust and scraps. Many thousands of fragments were found preserved in the crater. Millions of fine particles betray their presence as oxide particles mixed with the soil. Let us be frank and admit that at present all of us know far too little to speak in final terms regarding the possibilities characteristic of meteorite craters!

Further Notes on the Excavation of the Haviland, Kiowa County, Kansas, Meteorite Crater†

By H. H. Nininger

Abstract

The excavation of the Haviland, Kiowa County, Kansas, meteorite crater in 1933 has been described in a paper published in the *Proc. Colo. Mus. Nat. Hist.*, **12**, No. 3, pp. 9-15, 1933. This report contained an account of the distribution of the meteorite fragments within the crater. These were found to occur in a funnel-shaped formation, the smaller fragments peripherally toward the surface of the ground, and the larger ones nearer the center at the bottom of the funnel. This arrangement was interpreted as evidence of an explosion of the meteorite or of the air trapped between it and the soil at the instant of, or just before, the impact. The present paper presents some previously unpublished photographs [not reproduced here] of the work of excavation, and reports new findings in the soil of the region surrounding the crater. The new findings consist of a deposit of numerous small concretionary masses, which on chemical test show a content of nickel. On breaking, these concretions are seen to be composed of ordinary soil grains cemented together by oxides of iron. In the center of each concretion is found a small blackish, or bluish-black, spot which apparently represents the altered remnants of the nickel-iron grain which was responsible for the formation of the nodule. These small masses were very numerous in certain areas investigated out to distances as great as a mile from the crater. Under a grant from the J. Lawrence Smith Fund of the National Academy of Sciences, the region will be thoroughly explored with a view to discovering the extent and the nature of this deposit, in an attempt to find a satisfactory explanation.

†Delivered at the joint symposium of the S.R.M. and Section E of the A.A.A.S. on "Meteorite Craters," at the Fifth Annual Meeting of the Society in June, 1937.

An Unusual Oxidized Mass of Canyon Diablo, Arizona, Iron*

By L. F. Brady,
Mesa Ranch School, Mesa, and Museum of Northern Arizona, Flagstaff

Abstract

An unusual oxidized mass of Canyon Diablo, Arizona, iron, containing a large (about a 100-g.) graphite inclusion, is described. The oxidized material shows distinct traces of the original Widmanstätten figures, the kamacite bands being represented by lines and irregular spots of honeycombed texture, one group of which shows a definite triangular arrangement. The graphite inclusion is kidney-shaped, and shows no traces of included crystalline iron (as in the case of the graphite mass described as "Elden, Arizona"), but is traversed by numerous cracks filled with oxidized iron, thus suggesting fracture of the graphite before the solidification of the surrounding nickel-iron. Traces of nickel (probably as hydroxide) are visible in the altered material near the surface of the graphite. It is suggested that the graphite separated from a molten mixture before the solidification of the meteorite as a whole, and that the presence of the graphite modified the differential crystallization of the nickel-iron alloys in its immediate neighborhood.

*Delivered at the Fifth Annual Meeting.

Preliminary Announcement of the Sixth Annual Meeting

With the approval of the Council, the President and the Secretary announce that the Sixth Annual Meeting of the Society will be held in connection with the regular summer meeting of the American Association for the Advancement of Science in Ottawa, Ontario, Canada, at 10:00 A.M. and 2:00 P.M. on Tuesday, June 28, and Wednesday, June 29, 1938.

It is hoped that there will be a large attendance at this meeting. This will be the first time that the Society will meet so far east and in a country other than the United States. It should be an inducement to members living in the Eastern States to attend the meeting because of their nearness to Ottawa. On the other hand, western members will find a trip through the Great Lakes region and eastern Canada a very pleasant diversion. Moreover, one of the great meteorite collections of North America is preserved and exhibited by the Geological Survey of Canada in Ottawa.

Members who are engaged in any kind of research on meteorites or meteors are cordially invited to present papers at this meeting and are urged to begin now to look forward to participation in the program. It is hoped also that a joint session may be arranged with another group or with other groups, whose activities are related to the science of meteoritics. Those persons who were privileged to be present will recall how very successful was the joint symposium of the Society and Section E of the Association, on the general topic of "Meteorite Craters," at the Fifth Annual Meeting on June 22, 1937, at Denver, Colorado.

H. H. NININGER, *President*
ROBERT W. WEBB, *Secretary*

Errata in the January, 1938, Issue

The following *errata* in the *C.S.R.M.* in the January, 1938, issue of *P.A.*, **46**, 47-54, were due to a delay in the receipt and return of the proofs, caused by the rush of the recent holiday season:

(1) P. 47, footnote, first line: "F. W. Sassirer" should read "F. W. Cassirer."

(2) P. 50, third line from the bottom of the page: "western (Moravian)" should read "eastern (Moravian)."

(3) P. 53, first line of the tabular material at the top of the page, under the heading "Country": "Syria, and Persei" should read "Syria, and Persia."

(4) P. 53, second line below the table: "doubtless in masses" should read "doubtless in many masses."

Geminids and Quadrantids Observed

Two fine showers of meteors were observed here, the Geminids, December 10-13, and the Quadrantids, January 2-4, 1938, with results as follows:

1937				
Dec. 10	120 minutes	0	Brilliantly clear.	
Dec. 11	60 minutes	20	Brilliantly clear.	
Dec. 12	60 minutes	92	Brilliantly clear.	Many very swift Leonids.
Dec. 13	60 minutes	92	Brilliantly clear.	Many very swift Leonids.
	Mostly faint, short, without trains, some very fine fireballs.			
1938				
Jan. 1	Cloudy, snow.			
Jan. 2	First 60 minutes	44	Brilliantly clear Jan. 2, 15° F.	
Jan. 2	Second 60 minutes	108	Extremely swift Leonids active from γ.	
Jan. 3	Clouding up 30 m.	3	Extremely swift Leonids active from γ.	

January 2 there were as many as 6 a minute at 16:30 when it clouded suddenly. The radiant shifts very rapidly northeastward about 1 degree per hour. The gamma Leonids crossing Quadrans confuse the mapping unless the most extreme care is taken, and this has led observers in the past to conclude that the Quadrantids emanate from a large area instead of a rather small area. The other stray shower from α Ursae Minoris only adds to the confusion in mapping. However, the γ Leonids are the swiftest shower of the year and the Ursa Minorids are one of the slowest. The January shower lasts about 14 hours and often the best display is seen in England when it is not dark in the United States or the opposite. However, it is a very rich shower with many fine fireballs and without trains.

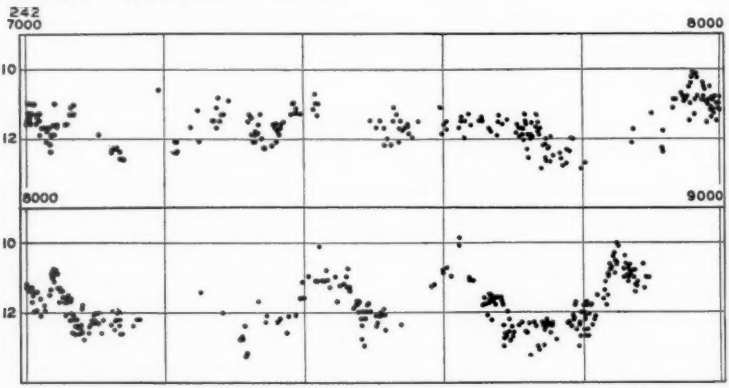
Cape Elizabeth, Maine, January 20, 1938. ROBERT M. DOLE.

VARIABLE STARS

Variable Star Notes from the American Association of Variable Star Observers

By LEON CAMPBELL, Recorder

V Sagittae, An Old Nova?: The variations of V Sagittae, 201520, have been a subject for much discussion in past years. Observers have assigned various periods, ranging from 12 to 18 days for a short-term period and from 96 to 600 days for a long-term period. On the basis of the claim that two definite periods existed, Father O'Connell classed the star with such double-period variables as DF Cygni, V Hydrae, and W Orionis.



V SAGITTAE, 201520, 1932-1937

Although rather abrupt and sudden changes in brightness over a range of about two magnitudes do appear, which, for a time, seem to indicate a short-term periodicity, this activity does not persist with enough constancy to be considered as conclusive evidence. In fact, no one value for either short or long-term period has as yet been found which satisfies all the observations. A plot of the available observations made since 1932 indicates a period of about 230 days: the irregulari-

ties observed in earlier years, however, prevent us from considering this value as definitely established.

The suggestion of Ryves, endorsed by Joy and C. Payne-Gaposchkin, that the star may be the remains of an old nova, seems to be more nearly correct than Father O'Connell's that the star, with a short and long-term of 17 and 600 days, respectively, belongs to the class of variables with double periods.

Variations in brightness approaching two magnitudes have been previously observed for novae: for example, Nova Persei, 1901, and Nova (RS) Ophiuchi. The latter is known to have had two marked and sudden outbursts at intervals of 35 years, and since its most recent bright maximum in 1933 it has shown progressive variations over this range in a period of between 300 and 400 days. Nova Persei, 1901, has long been known to vary irregularly since its return to normal minimum brightness.

Doubtless there are many stars with light variations similar to those of V Sagittae which may relate them to old novae. T Orionis and Z Andromedae may well be considered as such examples.

The Eclipsing Variable Epsilon Aurigae: This remarkable eclipsing variable with the longest period known for this type of star, namely 27 years, was first announced as variable over a hundred years ago by Fritsch. In 1821 he noted that the star was fainter than it had been in earlier years. His discovery seems to have been soon forgotten, for it was not until 1843 that Schmidt suspected the variability of the star, although it was not then at actual minimum. Confirmation was made by Heis and Argelander in 1847 when the star was at one of its regular minima. It remained for Ludendorff, who in 1903 assembled all the observations then available, to propose the eclipsing binary character of the variations and to quote a 27 year period. Later, because of the seeming conflict between photometric and spectroscopic data, he was led to question this view.

Epsilon Aurigae takes about six months to decrease from maximum to minimum; it remains about eleven months at minimum; and another six months to attain maximum brilliancy again. In other words, nearly two years of the total 27 years of the star's period are spent in passing through eclipse phase.

In Shapley's investigation of 90 eclipsing variables, made in 1914, this star is listed as possessing the greatest diameter of all the eclipsing binary stars, one component having a radius of 74 or 156 times that of the sun, and the other either 739 or 419 times, depending on which solution proved to be the more nearly correct. Thus, more than twenty years ago it was recognized that ε Aurigae was a very extensive star; and since then only a few others have been considered in that class, namely Zeta Aurigae and VV Cephei.

The long-awaited 1928-29 minimum settled many puzzling problems connected with the star. Where for some time it had been supposed that the "F" companion to the principal star revolved in such a manner as to pass actually behind the main star in going into eclipse, it is now shown by the Yerkes astronomers that the "F" companion does not actually pass behind the star, but at such an angle that the light shines through the outer shell: a sort of grazing effect. It appears that the main star has a kind of Heaviside layer surrounding it which is ionized by the light of the companion star, and that the light of the "F" companion is diminished by three-quarters of a magnitude in passing through this shell of ionized gas. The suggestion is truly novel and appears to clear up many of the spectroscopic difficulties previously encountered. The Yerkes astronomers now consider that the eclipsing binary hypothesis is definitely proven. Dr. Shapley's prediction in 1914 that

the 1928-29 minimum would solve many of the problems as to the eclipsing binary character of the star is therefore fulfilled satisfactorily.

Drs. Kuiper, Struve, and Strömgren at Yerkes Observatory give us some interesting additional facts about this system. The radius of the "F" companion is estimated to be about 200 times, and that of the principal star nearly 3000 times the radius of the sun. Epsilon Aurigae appears to be the largest star known to exist, comparable in size to that of our whole solar system. The masses of the companion and the principal stars are, respectively, computed to be 44 and 29 times that of the sun, while the temperature of the principal star is found to be about 1400° C. The absolute magnitude of the companion star is —7. It would appear that such a large per cent of the light of the main star is so far in the infra-red that little, if any, of its light reaches the observer's eye, whereas the "F" companion is well observed. The parallax of the system is assumed to be 0".0010, making it slightly more than 3000 light years distant.

The fact that Schmidt suspected ε Aurigae of variability in 1843, four or five years before its minimum was due, leads one to suspect that the star is not uniformly bright during maximum phase. Wendell, using a polarizing photometer at Harvard, found that its magnitude was 3.15 during the years 1904 to 1912, with an average deviation $0^{M}.09$. Although the next minimum is not due until the middle of the present century it would be worth while to have the star carefully observed at intervals, to prove, or disprove, the constancy of brightness between minima. This should apply especially to the early 1940's when a secondary minimum, if such exists, should occur.

The Eclipsing 44i Bootis: The variability of one of the components of the visual binary 44i Bootis, was discovered by Schilt when he noted that the spectrum, G2p, closely resembled that of the eclipsing binary W Ursae Majoris. The angle of separation of the components, A and B, was then about three seconds of arc, and the respective magnitudes are 5.3 and 6.1. Here we have the fainter component of a system, whose period is 205 years, varying as an eclipsing star in a period of a little over a quarter of a day, $0^{d}.2678$. Kuiper has determined the period to a high degree of accuracy, namely to nine decimal places, from observations covering 12 years.

Photoelectric measures of the combined light of the A and B components were made by Calder in 1935 and 1936 in terms of a star about half a degree distant. A study of these observations brings out some interesting facts. The curve for each year shows differences (which cannot be considered as accidental errors of observation) with regard to the zero point of the light curve and the relative depths of the several minima. The 1936 curve is definitely fainter than the 1935 curve, to the extent of about a half-tenth of a magnitude, which for photoelectric work cannot be ignored. This difference can probably be ascribed to the change in magnitude of the brighter A component (spectral class G0). A résumé of the differences found in 1935-36 showed: First maximum brighter than second maximum in 1935. Second maximum brighter than first maximum in 1936. Secondary minimum in both years definitely more shallow than the primary minimum.

The amplitudes appear to have undergone a change between 1935 and 1936, the primary minimum being deeper and the secondary, more shallow in 1936. This might be accounted for by the change in the moving line of apsides, not unusual in the case of a close binary system. There is a slight displacement of the secondary minimum with respect to the midway position between primary minima, which might be considered as negligible in 1935, but which cannot be overlooked in the 1936 curve.

We have in this W Ursae Majoris type of eclipsing binary system (the fainter component B of the visual binary) two elliptical, solar-type stars probably of nearly equal dimensions and surface luminosity, and almost in contact. While the observed amplitude at principal minima is only 0.16 of a magnitude, the true amplitude would be 0.6—a normal range for a W Ursae Majoris type variable—were it not for the presence of the bright A component.

1936, A Year of Novae: If any one year can be considered as a nova year, one which is particularly distinguished for the appearance of galactic novae, the year 1936 certainly holds that distinction. Six novae, belonging to our galactic system, made their appearance, two discovered visually, the others found on photographs.

Nova Sagittarii, 1936.32, discovered by Miss Burwell of Mount Wilson Observatory as a star with a peculiar spectrum on a plate of June 10, and later confirmed as a nova by Miss Cannon of Harvard from a study of the spectrum, was at maximum magnitude 6.5 on April 24. It apparently increased very suddenly from magnitude 12.7 on March 31 to magnitude 7.5 on April 2, remained for some three months near maximum, and then rapidly diminished in brightness, from magnitude 8.6 on June 25 to 12.0 on July 13.

Nova Sagittarii, 1936.37, discovered by Mrs. Mayall from Harvard nova patrol spectrum plates, was faint, below magnitude 16, on April 30, and bright, magnitude 10.8, on May 13. There is a possibility that it was somewhat brighter between these two dates. Early in October the nova had faded to below magnitude 14.5. Luyten had listed the star as variable, number 171.1937, but had not been aware of its nova character.

Nova Lacertae, 1936.46, discovered visually by K. Gomi on June 18, at magnitude 4.0, reached magnitude 2.0 two days later. It has now decreased in brightness to nearly the twelfth magnitude.

Nova Aquilae, 1936.60, discovered photographicaly by Tamm on September 18, apparently rose from a magnitude fainter than 11.0 on July 17 to 9.7 on July 20. Early in October it had reached a maximum brilliance of magnitude 7.2.

Nova Aquilae, 1936.73, the second to be discovered by Tamm from photographs, was of magnitude 7.0 on October 7. It appears to have been on the increase between September 19 and 22, magnitudes 13.0 and 6.6, respectively. Maximum brilliance was attained about September 24.

Nova Sagittarii, 1936.76, was discovered visually by Okabayashi on October 4, when it was of the fifth magnitude. It was apparently on the decrease to minimum when found, and because of its low altitude, for northern observers especially, it soon became too low for observation.

The David B. Pickering Nova Medals have been awarded by the A.A.V.S.O. to Messrs. Gomi and Okabayashi of Japan as the original discoverers of Nova Lacertae, 1936.46, and Nova Sagittarii, 1936.73, by visual methods.

Supernova in IC 4719: Another supernova is announced from Harvard. It was found in the constellation Telescopium by Miss C. D. Boyd during her examination of Milky Way Fields for variable stars, is associated with the extragalactic nebula, IC 4719, and was of magnitude 13.6 on October 11, 1934. The Harvard plate collection reveals no appearance of the star prior to 1934. On September 27, 1934, it was fainter than magnitude 15.3; on October 3 it was of magnitude 15.1, and on October 7, magnitude 13.7. In April, 1935, the star was again fainter than 15.3. It probably did not attain a magnitude appreciably brighter than the 13.6 observed.

Observers and Observations: The following observers have contributed observations of variable stars during the month of December, 1937, as given in the table.

Observer	Vars.	Observations	Observer	Vars.	Observations
Allen, L. B.	1	3	Loreta	129	362
Ancarani	14	28	Meek	10	10
Andrews	4	4	*Mass	4	6
Baldwin	113	170	McLeod	28	60
Ball	5	6	*McMaster	4	6
Ballhaussen	21	26	Monnig	1	1
Blunck	14	14	Murphy	34	67
Bouton	41	51	*Myers	5	7
Brocchi	29	42	*Nicholson	5	7
Callum	72	140	Palo	3	3
Cameron	2	2	Peltier	164	208
Carpenter	211	236	Pursell	2	2
Chartier	34	36	Recinsky	6	19
Cousins	18	50	Rosebrugh	18	92
Crout	7	7	de Roy	14	41
Dafter	9	23	Ryder	20	20
Diedrich	6	15	Seely	5	14
Ellis	8	9	Shult	13	13
Escalante	85	161	Sill	18	18
Fairbanks	9	16	Smith, F. P.	22	28
Fernald	4	8	Smith, F. W.	4	10
Franklin	33	33	Smith, J. R.	36	37
*Fromins	1	1	Smith, L.	10	10
*Gemill	6	13	*Smith, M.	4	6
Gregory	151	176	*Thompson	5	6
Hartmann	156	293	Topham	11	11
Haas	8	29	Treadwell	17	44
Hiett	22	55	*Trautman	5	6
Hildom, A.	19	25	Vassar	7	7
Holt	41	47	Walton	5	15
Houston	90	449	Ward	1	1
Howarth	16	17	Watson	36	84
Jones, E. H.	108	425	Webb	48	49
Kearons	10	33	*Williams, L.	4	6
Keuziak	2	2	Woods	9	46
Kirkpatrick	36	172	Yamasaki	40	57
de Kock	44	146			
*Lewis	5	6	74		4346

Those marked (*) are student observers working under the guidance of Walter Haas at Mount Union College, Alliance, Ohio.

January 18, 1938.

Notes from Amateurs

The Cleveland Astronomical Society

The first social event of the new year was held at the home of Dr. and Mrs. Harry D. Piercy, 2911 Paxton Road, Shaker Heights, Friday, January 7, at 8:00 P.M. The evening began with a talk by Mr. David Dietz, science editor of the Scripps-Howard papers and author of several books on scientific subjects. Best known perhaps is his "Story of Science" which should be in the library of all those interested in astronomy. He spoke on "The Present Trend of Science." Being a fine speaker his talk was of great value and much appreciated by our mem-

bers and friends. This was followed by piano selections by Dr. Piercy whose musicianship is of a high order and a source of much pleasure to his friends. Refreshments were then served. Our president, Dr. J. J. Nassau, is the author of a history of the life of the late Ambrose Swasey which appeared in a recent issue of POPULAR ASTRONOMY, under the title "Ambrose Swasey, Builder of Machines, Telescopes, and Men." Also a paper by our good friend, S. W. McCuskey, is found in the January issue under the title "Radial Velocities from Objective Prism Spectra." Since the publication of our list of astronomical books a volume has come to hand that deserves special notice. It is just off the press and was picked up in Brussels last October. "Sur Les Autres Mondes" by Lucien Rudaux, Director of the Observatory of Donville, France, is the most finely illustrated book on astronomy ever published. Of large size it contains 406 beautiful plates, many in color. Very little knowledge of French is required by the reader to appreciate it. It is an unusual volume.

DON H. JOHNSTON.

14 Lincoln Drive, Cleveland, Ohio.

Detroit Astronomical Society

The past year brought to the Detroit Astronomical Society many fine speakers who served to stimulate the activities of the society and promote a general interest in astronomy in the Detroit area.

Emert R. Phelps, Associate Professor of Physics at Wayne University, was elected President at the annual business meeting in January. The staff of the University of Michigan contributed greatly to our programs. Professor Carl W. Rufus, well known for his extensive study of the historical aspects of astronomy, gave an illustrated lecture on Early Known Astronomy. Professor Allen Maxwell, noted for his computation of orbits, discussed the various methods of determining the orbits of comets with limited observations. Mr. Duane Sawyer, technician at Lake Angelus, presented the latest Solar Motion Pictures taken at the McMath-Hulbert Observatory. At the invitation of Mr. Robert R. McMath, the Society visited the McMath-Hulbert Observatory and had the good fortune to see the Solar Tower in operation. A talk was given by the writer on variable stars and a description of the work of the American Association of Variable Star Observers, together with an appeal for new observers in this field. Mr. Nickolson, one of our members, gave us a very interesting talk on his sun-spots theory, entitled "Sun Spots and Ice Ages."

The fall meetings opened with a visit to the Cranbrook Institute of Science Observatory at Bloomfield Hills at which time Dr. R. L. Hatt extended the Society a generous invitation to use the facilities and equipment of the Institute and to hold meetings in the beautiful auditorium. Professor E. R. Phelps, our President, gave a most interesting talk on the Calendar, followed by an explanation by the writer of the Nova Research Program being conducted by The American Amateur Astronomical Association and expressed the hope that members of the Society would join in this work.

The long-anticipated visit of the world famous amateur astronomer, Leslie C. Peltier, was realized late in the fall. Mr. Peltier spoke at a meeting held at Cranbrook Institute of Science on the subject "Useful Work for the Amateur," and was induced to relate some of his experiences in observing and the methods he employs. His talk was particularly inspirational and timely as members of the Society are coming to realize the urgent need for active observers.

At the final meeting of the year Dean George I. Altenburg, of the Highland

Park Junior College, spoke of the educational work in astronomy that could be done among the Boy Scouts. A committee was appointed to direct volunteers in this work.

CLAUDE B. CARPENTER, *Secretary.*

34624 Chestnut Street, Wayne, Michigan.

Amateur Astronomical Society of New Haven

The meeting of the New Haven Amateur Astronomical Society held on December 18 proved a very interesting and instructive session. The Meteor Observing group reported that it had charted a total of 319 meteors during the three nights of the Geminid shower.

Mr. Thomas Edmondson of Yale (one of our members) as speaker of the evening gave a very interesting talk on "The Moon." He cited some of the early ideas and impressions of the moon, one of which was that it was thought to be a huge crystal and that the apparent unevenness of its surface was caused by the reflection of the mountains and valleys of the earth.

Various and many erroneous ideas regarding the moon were held until Galileo, with his small telescope, cleared away much of the mystery by observing the planet Jupiter, with its four satellites circling around it, and checking it with our own moon and by close study, showed and partly convinced a skeptical public that there were mountains, valleys, "craters," and sea beds plainly visible. Mr. Edmondson exhibited many photographic slides showing the moon's surface well defined and delineating to advantage the many and interesting details of its surface irregularities. He called special attention to the fact that the walls surrounding the "craters" were relatively very low in relation to the diameter of the "craters," proving this fact by mentioning the following diameters and heights of walls:

Archimedes	50 miles diam., 4,000 ft. high
Eratosthenes	38 miles diam., 16,000 ft. high*
Copernicus	56 miles diam., 11,000 ft. high
Clavius	142 miles diam., 12,000 ft. high
Tycho	54 miles diam., 17,000 ft. high
Plato	60 miles diam., 3,000 to 4000 ft. high

*8,000 ft. high, 8,000 ft. depressed floor.

He explained that the extremely rough mountainous surface of the moon was the cause of Baily's Beads seen just before the total eclipse of the sun.

Immediately following this talk Mr. Doolittle exhibited some interesting moving pictures of the moon, clearly showing the progress of the sun's direct light and corresponding shadows slowly creeping over the valleys, "craters" and, finally, the cones of the mountain peaks alone illuminated.

The next meeting of the society will be the celebration of its first anniversary in the form of a public meeting addressed by Professor Wm. Barton, Jr., Associate Curator of the Hayden Planetarium, on the "Peruvian Eclipse Expedition" of which he was a member.

F. R. BURNHAM, *Secretary.*

New Haven, Connecticut, January 8, 1938.

Amateur Astronomical Society of New Haven

The New Haven Amateur Astronomical Society observed its First Anniversary on January 15 by holding a public meeting in Sage Hall with an attendance of about one hundred and fifty.

Professor Wm. Barton, Associate Curator of Hayden Planetarium, gave an illustrated lecture on the "Peruvian Eclipse Expedition" using colored slides and movies. He stated that the first recorded eclipse was on October 22, 2137 B.C., ac-

cording to the Chinese records. This eclipse occurred during the reign of Chung Kang the 4th, Emperor of the Heai Dynasty and it was the duty of astronomers of that time not to particularly observe the eclipse but to warn the people of its coming, and when it did appear to shoot arrows into the air and make great noises so as to scare away the monster that was destroying the sun.

This first eclipse was not announced by the astronomers owing to a wine celebration the preceding night so that the nation was taken by surprise and the end of the world was thought to be approaching. As a result the indignant authorities ordered the death of the two negligent astronomers, Ho and Hsi.

The June 8, 1937, eclipse was of 7 min. 4 sec. duration over the Pacific and the path in the form of a curve entered into every one of the four hemispheres, but passed over land only at Canton Islands and Peru, and, odd as it may seem, it ended the day before it started, owing to crossing the International Date Line.

At Peru, where the expedition was located, the observations were made with the sun only six degrees above the horizon and not in a very good position to photograph, but one of the three groups was at sea level, one on the top of the Andes at 14,600 ft. elevation, and Major Stevens at an elevation of 25,000 ft. in an airplane. The sea level group did the broadcasting over the Columbia Network.

Professor Barton's pictures of the eclipse and the country through which the expedition passed, climbing up 14,000 feet, and his very fine description of it all were most interesting.

F. R. BURNHAM, *Secretary.*

New Haven, Connecticut, January 24, 1938.

The Joliet Astronomical Society

The Joliet Astronomical Society resumed its regular meetings last October with Everett C. Shaw as President, Robert L. Price as Secretary, and Dr. H. D. Cohn as Treasurer. The vice-presidents and their departments are: Frank M. Preucil, Program Chairman; Dr. Walter B. Huey, Reporter of Astronomical Progress; Leonard M. Onsgard, Coördinator of Research.

The outstanding meeting of the fall season was addressed by E. P. Martz, Jr., of Oak Park and the University of Chicago, whose topic was "Planetary Atmospheres." The group was pleased with Mr. Martz's recounting of his experiences at various observatories, his slides, and the samples of photographs obtained last summer at Mt. Wilson.

On December 7 the society gave a surprise house-warming for Mr. and Mrs. Price who had recently moved into their own home. Following a buffet supper, they were presented remembrances from all present. The evening was spent in various competitive games with several teams competing. Spelling of astronomical terms in a dictation contest, while a passive sport, brought on most arguments. The evening was a great success due to hearty participation by all and through the planning and direction of Mr. and Mrs. Frank M. Preucil.

ROBERT L. PRICE, *Secretary.*

Joliet Junior College, Joliet, Illinois, January 10, 1938.

Louisville Astronomical Society

On January 4, the Louisville Astronomical Society had the honor of a visit from Dr. George Van Biesbroeck, Professor of Practical Astronomy at the Yerkes Observatory of the University of Chicago. Dr. Van Biesbroeck was on a lecture trip to New York and the Louisville Society was specially fortunate in arranging for a visit at this time.

A dinner in honor of Dr. Van Biesbroeck was given at the Brown Hotel by

members of the Society, after which he lectured on "Double Stars" at the regular meeting of the L.A.S. in the Alumni Rooms of the University of Louisville. Dr. Van Biesbroeck's charming manner, with his very interesting subject so well illustrated with slides, made a most enjoyable evening for the many members and their friends who attended. Following the lecture Dr. "Van B." was kept busy for some time answering questions from the floor.

The following morning Mr. and Mrs. Gordon Miller were hosts at breakfast, at their home in Glenview, for Dr. Van Biesbroeck and members of the L.A.S. The Millers have a fine Clark instrument and are generous in sharing it with the many visitors to their observatory. They are also doing some experimental celestial photography.

During his visit in Louisville, Dr. Van Biesbroeck was the house guest of Mr. and Mrs. Oscar W. McCarty, who are frequent visitors to the Yerkes Observatory. Mr. McCarty is a pioneer in the promotion of interest in astronomy in Louisville.

January 9, 1938. MARY EBERHARD, *Secretary.*

General Notes

Professor William H. Pickering, a recognized leader in astronomical researches, and for many years a most valued contributor to this magazine, died recently at his home in Mandeville, Jamaica. Further details are not now at hand, but an appropriate biography of Professor Pickering will appear later.

It is of interest to note that Professor Pickering's final contribution, "The Constellations," appears in this issue, concurrently with this notice of his death.

Dr. Walter E. Bernheimer, professor and research worker in the observatory of the University of Vienna, died on December 14, 1937, after an extended period of illness, at the age of 45.

Perkin, Elmer and Moffitt is the new name of the firm formerly operating as the Perkin-Elmer Company. With the addition in personnel the firm now specializes in optical design and consultation. Dr. G. W. Moffitt is Director of the Technical Staff, and Dr. Frank E. Ross, Associate.

Symposium on Physics and Astronomy at Yerkes Observatory

The Department of Physics of the University of Chicago and the Yerkes Observatory are planning to organize a symposium on *Recent Progress in the Interpretation of Molecular Spectra and in the Study of Molecular Spectra in Celestial Objects.*

The symposium is to start on Wednesday, June 22, and will presumably last four full days. The following speakers have tentatively agreed to participate in the program:

Professor Gerhard Herzberg, Department of Physics, University of Saskatchewan, Saskatoon, Sask., Canada.

Professor David M. Dennison, Department of Physics, University of Michigan, Ann Arbor, Michigan.

Dr. Hans G. Beutler, Department of Physics, University of Chicago (formerly at Kaiser Wilhelm Institut, Berlin).

Professor John T. Tate, Department of Physics, University of Minnesota, Minneapolis, Minnesota.

Professor Robert S. Mulliken, Department of Physics, University of Chicago.
Dr. Rupert Wildt, Princeton University Observatory, Princeton, N. J.
Dr. Arthur Adel, Lowell Observatory, Flagstaff, Arizona.
Professor N. T. Bobrovnikoff, Perkins Observatory, Delaware, Ohio.
Dr. G. H. Shartley, Department of Physics, Ohio State University, Columbus, Ohio.
Dr. Karl Wurm, Yerkes Observatory, University of Chicago (formerly at Astrophysical Observatory, Potsdam, Germany).
Dr. W. W. Morgan, Yerkes Observatory, University of Chicago.

The titles of the lectures will be announced later.

The scientific sessions will take place at the Yerkes Observatory, Williams Bay, Wisconsin. The headquarters at the time of the symposium will be at College Camp which adjoins the grounds of the Yerkes Observatory. The rate for room and board will be $12.75 for two persons in a room, for four full days. It is suggested that the members of the symposium plan to have lunch at the main dining room of College Camp on Wednesday, June 22, in which case the rate would apply until Sunday morning after breakfast. A somewhat higher rate will apply for rooms occupied by one person. Reservations for room and board at College Camp should be made as early as is possible, and certainly not later than Monday, June 13. These reservations may be made by writing to the Yerkes Observatory, Williams Bay, Wisconsin. Accommodations at a slightly lower rate can probably be secured in boarding houses and private residences in the Village of Williams Bay.

All astronomers and physicists are cordially invited to attend the symposium and to participate in the scientific discussions. Graduate students attending the summer school of the University of Chicago in the Department of Physics or at the Yerkes Observatory are also invited. Registrations for the summer school should be made in the usual way through the offices of the University of Chicago.

Summary of Sun-Spot Observations at Mount Holyoke College, 1937

Month	No. of Obs.	North of Equator No. of Groups	North of Equator Av. Lat.	South of Equator No. of Groups	South of Equator Av. Lat.	Av. No. groups at one Obs.	New Groups
January	15	26	+18°5	25	−17°2	10.07	51
February	15	34	19.1	20	16.8	11.80	41
March	19	36	17.3	20	15.4	7.89	47
April	16	24	13.9	21	16.4	7.00	38
May	15	23	15.4	15	17.5	8.07	35
June	14	25	14.7	10	15.3	7.71	32
September	8	14	17.6	8	16.1	8.75	22
October	17	23	15.1	14	16.8	7.06	30
November	14	14	14.1	15	13.5	5.64	21
December	11	7	17.1	16	15.9	4.45	22
Totals	144	226		164			339

Average number of groups at one observation 7.90
Average latitude of spots north of equator +16°5
Average latitude of spots south of equator −16.2

The majority of the observations were made by Mrs. Helen Porter Jose. On no day was the sun seen free from spots.

It is unfortunate that the period during which observations were discontinued (June 17 to September 20 and December 16 to 31) includes the markedly active months of July and August. Our peak for the year occurred in the nine-day period

beginning January 27 when 15 or more groups were counted on seven of the days, the maximum being 18 on January 30 and February 3. Our average number of groups at one observation in February, 11.8, may be compared with 12.0 noted at Mount Wilson as the mean number of groups observed daily.*

The systematically greater spottedness of one solar hemisphere (center near longitude 195°) as compared with the other is especially striking in the observations of the first six months of the year.

ALICE H. FARNSWORTH.

John Payson Williston Observatory, January 25, 1938.

*P.A.S.P., **49**, 121, 1937.

Occultation of Zeta Tauri

The following observations of the occultation of Zeta Tauri by the moon were made here last night.

Date 1938 Jan. 13		h m s	Observation
Immersion,	E.S.T.	10 32 59.0	Good.
Emersion,	E.S.T.	11 38 5.0	Poor, clouds.

This observatory is the former private observatory of the late Mr. Frank E. Seagrave and is maintained by the Skyscraper Club, Inc., of Providence, Rhode Island.

Seagrave Memorial Observatory, North Scituate, Rhode Island, January 14, 1938.

Observations of Eros

In the preceding issue, page 57, Mr. Leon Campbell called attention to the desirability of observations of the light variations of Eros during the months of January, February, and March, 1938, to sustain or disprove several predictions made for the variation. Preliminary reduction of photographic observations made at Harvard show brightness minima at J.D. 8894.495, 8898.757, and 8907.650. The range is small on the earliest plates, but is obvious on the last night with an amplitude of about a half magnitude, in keeping with the prediction made by the writer in *Harvard Circular* 419.

A rapid increase in the range is predicted to reach 1.5 magnitudes on February 5 and return to practically zero by the end of March. Observations of range, magnitude, and of the color and spectrum throughout the 5 hour 12 minute period of variation are greatly desired.

FLETCHER WATSON, JR.

Harvard College Observatory, Cambridge, Massachusetts, January 18, 1938.

The Aurora of January 25, 1938

The most brilliant auroral display since March 22, 1920, was seen here during the early evening hours of January 25, 1938. Shortly after sunset an intense red glow was noted in the sky just northwest of the zenith. At first it was thought to be due to the sunset glow but a few moments of observation corrected this idea. The patch of ruddy light grew, shifted position, transformed itself into an intensely brilliant shaft of crimson light and rapidly became an arch that extended from the eastern horizon to the western sky line.

The most spectacular portion of the display occurred from 6:45 P.M. to 7:15 P.M., E.S.T. At this time rapidly shifting areas of pale green light, huge waving curtains, and brilliant streamers occupied almost the entire northern half of the sky. A tremendous arch of crimson light, very intense in color at the eastern and

western ends, spanned the sky, following very nearly the line of the ecliptic. This arch was, on the average, about 6 to 7 degrees in width. The color can best be compared to that produced by an electrical discharge through a neon gas tube. To the best of my knowledge such a brilliant red display has never before been seen in these latitudes.

The activity at 7:00 P.M., E.S.T., extended from a point in the southwestern sky, entirely around the northern horizon, to a point just south of east, nearly to Sirius. A striking feature of the display at this time was the extension of numerous rays, of apple green and pale pink color, up from the horizon like the ribs of an umbrella, to a common point in the zenith. Here they joined in a circle or "auroral crown" in the center of which shone the Pleiades. By 7:40 P.M. the spectacular feature had died away and only a few hazy patches and streamers of light remained. For about two hours after this, sporadic outbursts of activity were noted behind the low-lying black clouds and a faint glow persisted until after midnight, low in the north, but no more striking manifestations were seen.

The huge group of sunspots, visible to the naked eye as a single spot, which was facing the earth January 16 to 18, has now disappeared around the western limb of the sun. Observation of the sun on January 25 at 12:30 P.M., E.S.T., showed only one spot of any size. This was about one day east of central. Today (January 26) this spot is central and north of the equator, and is followed by a small group of tiny spots about half way from the eastern limb to central.

Although brief, this brilliant auroral display may well be termed one of the most spectacular of modern times.

LEWIS J. BOSS.

North Scituate, Rhode Island, January 26, 1938.

Aurora Observed in Iowa

A very beautiful display of aurora was observed here between shortly after midnight and sunrise Saturday morning, January 22. I looked out of the east window of my room about 3:00 A.M. to see if the sky was clearing after a cloudy week. I at once noticed that a bright aurora was in progress, but, seen through thin clouds, at this time no streamers could be seen and the general color in the northeast sky was somewhat orange tinted. I did not awake again until morning but learned from a number of people that between 5:30 and 6:15 A.M. the display was very striking, consisting of streamers and beams and extending upward beyond the zenith and colored a brilliant red. At 12:30 P.M. I observed the sun and but one of the giant groups of spots which was observed a week previously was visible nearing the western limb. Eight other small spots were scattered along the disc. Observing the giant spot group with the spectroscope I soon found it quite active, the Hα line being entirely reversed and agitated the full width of the spot.

The display was the finest yet seen here during the present active condition of the solar cycle. Some former displays and coincident solar disturbances were described in a paper I communicated to P.A., Vol. XLII, No. 1, January, 1934.

Alta, Iowa, January 24, 1938.

D. E. HADDEN.

POPULAR ASTRONOMY

CONTENTS

FEBRUARY, 1938

THE FIFTY-NINTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY, WITH PLATE I AND KEY, DEAN B. MCLAUGHLIN 67

MEETING OF SECTION D (ASTRONOMY), AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, HARLAN TRUE STETSON 69

THE COMET-SEEKER HOAX, HEBER D. CURTIS 71

THE PARTIAL LUNAR ECLIPSE OF 1937 NOVEMBER 18, ALEXANDER POGO 76

THE CONSTELLATIONS, WILLIAM H. PICKERING 78

SIGNS OF THE ZODIAC, F. M. GARLAND 80

A CONCEPT OF GRAVITATION, THADDEUS MERRIMAN 87

FRAGMENTARY NOTES ON ASTRONOMY IN JAPAN, YASUAKI IBA 89

Planet Notes for March, 1938 97

Occultation Predictions 99

Asteroid Notes 99

Comet Notes 100

Periodic Comet Encke, — Comet 1935 *d* (Van Biesbroeck), — Periodic Comet 1927 VI (Gale).

Meteors and Meteorites 101

Meteor notes from the American Meteor Society,—The resistance of the air to meteors,—Contributions of the Society for Research on Meteorites: A photograph of a nearly stationary meteor; A reply to Dr. L. J. Spencer's paper on "Meteorites and the Craters on the Moon"; Further notes on the excavation of the Haviland, Kiowa County, Kansas, meteorite crater; An unusual oxidized mass of Canyon Diablo, Arizona, iron; Preliminary announcement of the sixth annual meeting; Errata in the January, 1938, issue,—Geminids and Quadrantids observed.

Variable Stars 112

Variable star notes from the American Association of Variable Star Observers.

Notes from Amateurs 116

The Cleveland Astronomical Society,—Detroit Astronomical Society,—Amateur Astronomical Society of New Haven (two reports),—The Joliet Astronomical Society,—Louisville Astronomical Society.

General Notes 120

Personal notices,—Symposium on Physics and Astronomy at Yerkes Observatory,—Summary of sun-spot observations at Mount Holyoke College, 1937, — Occultation of Zeta Tauri, — Observations of Eros,—The Aurora of January 25, 1938,—Aurora observed in Iowa.

The principal articles of this magazine, beginning with Volume **15** (1907), are listed in the INTERNATIONAL INDEX TO PERIODICALS.